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# PROGRAM MANAGER RMA CONTAMINATION CLEANUP

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MATERIEL COMMAND

— COMMITTED TO PROTECTION OF THE ENVIRONMENT —

Composite Well Program  
Task 1, Task 11, Task 19, Task 21,  
Task 22, Task 25, Task 26, Task 36,  
Task 38, Task 39, Task 42, Task 44

Draft Final Report  
(Version 2.3)  
July 1988  
Contract Number DAAK11-84-D-0016  
(as part of Task 44)

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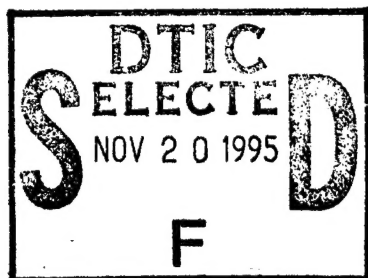
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## LITIGATION TECHNICAL SUPPORT AND SERVICES

Rocky Mountain Arsenal



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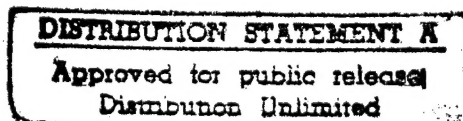
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PREPARED BY

ENVIRONMENTAL SCIENCE &amp; ENGINEERING, INC.

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U.S. PROGRAM MANAGER'S OFFICE FOR  
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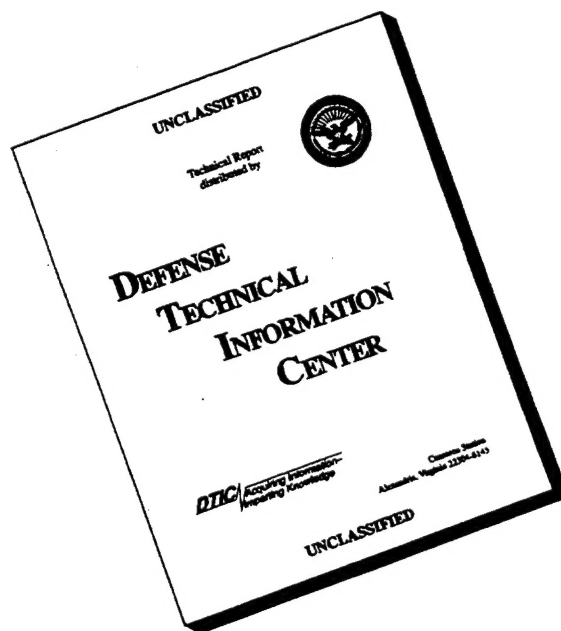
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13. ABSTRACT (Maximum 200 words) 200 ALLUVIAL AND DENVER AQUIFER WELLS AT 120 SITES HAVE BEEN PROPOSED UNDER 12 TASKS. THE COMPOSITE WELL PROGRAM (CWP) WAS ESTABLISHED UNDER TASK 44 TO PREVENT DUPLICATION OF WELL ACTIVITIES AND TO MAXIMIZE RESOURCES. THE CWP EVALUATED THE TASK SPECIFIC NEEDS WITH RESPECT TO THE OVERALL RMA HYDROLOGIC ASSESSMENT TO ENSURE ALL REQUIREMENTS FOR THE RESPECTIVE TASKS WERE FULFILLED, AS WELL AS MAKING SURE DATA GAPS IN THE REGIONAL SCHEME WERE SATISFIED. THIS REPORT PRESENTS TASK OBJECTIVES FOR TASKS 1, 11, 19, 21, 22, 25, 26, 36, 38, 39, 42, AND 44. FOR EACH WELL PROPOSED IN THESE TASKS, THE PROPOSED LOCATION AND RATIONALE FOR DRILLING ARE GIVEN. APPENDICES INCLUDE: 1. ON-POST WELL PRIORITY RATIONALE 2. OFF-POST WELL PRIORITY RATIONALE 3. WELL STATUS 4. DEEP WELL METHODOLOGY.				
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## 1.0 INTRODUCTION

### 1.1 PROGRAM SUMMARY

The Comprehensive Hydrologic Monitoring Program at Rocky Mountain Arsenal (RMA) is two-dimensional in function. As such, it is designed to accomplish the basic objectives of:

- o Regional monitoring; and
- o Site/source specific monitoring.

The regional component is directed to long-term hydrologic monitoring onpost at and offpost of RMA. As designed, it will provide the data necessary to monitor the water quality and hydraulic regime of the area. Conversely, site/source specific monitoring addresses the need for collection of detailed hydrologic data required to complete a site specific assessment. The efforts supplement the regional aspect of the program by providing additional hydrologic information at selected areas of RMA.

Under the ongoing cleanup effort at RMA, several hydrologic and/or hydrologic-related tasks have been or are currently being performed.

#### Task 4 - RMA Water Quantity/Quality Survey

##### **Objectives**

Under this task, a one-year ground-water and surface water surveillance program was performed at RMA to achieve the following objectives:

- o Satisfy the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and the substantive requirements of all applicable or relevant and appropriate Federal and State requirements that have application through CERCLA;
- o Confirm the existence and chemical nature of known contamination and monitor any changes in the lateral and vertical extent of contaminant migration; and
- o Develop a core data base for use in upcoming litigation and Remedial Investigation/Feasibility Study (RI/FS) analyses for RMA.

### **Scope-of-Work**

The purpose of the Task 4 Water Quantity/Quality Survey was to execute a one-year ground-water and surface water surveillance program capable of satisfying the various regulatory requirements, developing a litigation quality data base, and verifying the extent and nature of known contamination. In order to achieve these objectives, five distinct technical elements were conducted. These were as follows:

- o Review historical data;
- o Develop a monitoring program to achieve the above objectives;
- o Execute the monitoring program utilizing litigation quality sampling and analytical procedures;
- o Assess data quarterly for possible adjustments in the monitoring program; and
- o Compile the accumulated data at the end of the one-year program.

Data were collected during the period of October 1985 to September 1986. Efforts included an initial sampling of 320 onpost wells between October 1985 and March 1986, and two additional quarters of sampling (April to June 1986 and July to September 1986) from 188 wells. Water levels were obtained quarterly from 800 wells. No monitoring wells were installed under this task.

### **Task 25 - RMA Boundary Systems Monitoring**

#### **Objectives**

The objectives of Task 25 were to monitor ground-water flow and contaminant transport in and around the North and Northwest Boundary Containment Systems (NBCS and NWBCS), to define contaminant pathways in these areas, and provide chemical and hydrologic data for the operation of the NBCS and NWBCS.

### **Scope-of-Work**

The scope-of-work for Task 25 included:

- o A detailed geologic study of the Denver Formation (Fm) and the alluvial aquifer. This study entailed the construction of isopach maps, cross sections, structure contour maps, and other types of diagrams. It defined the configuration and extent of various rock and soil units that are important to the hydrogeologic framework of the boundary area and the migration of contaminants;

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- o Monitoring of wells to determine the distribution and concentration of contaminants and the configuration of piezometric surfaces associated with specific aquifers; and
- o Maps showing contaminants distribution and the configurations of piezometric heads along with pertinent geologic and hydrologic data to support the operations of the NBCS and NWBCS enabling them to increase operating efficiencies.

Data were collected for the period of September 1986 through December 1987. Water quality sampling was performed at some 145 wells and water levels monitored at over 350 wells on a quarterly basis. Monitoring wells were proposed at 21 sites. Wells were installed at nine of the proposed locations. All wells were alluvial completions.

#### Task 26 -- Ground-Water Treatment Study/Interim Action Assessment

##### **Objectives**

The objectives of Task 26 were to evaluate the ground-water flow systems in the South Plants, Basin A, and Basin A Neck region; to identify areas in this region for implementing Interim Response Actions (IRAs); and, to prepare an assessment of alternatives for the design and construction of an alluvial ground-water intercept and treatment system in the Basin A Neck area.

##### **Scope-of-Work**

The focus of the task has been revised twice. Originally a feasibility study evaluating the ground-water flow systems and developing conceptual ground-water collection and treatment systems for the South Plants and Basin A areas, the task was changed to an Alternatives Assessment for an IRA in the Basin A Neck area. The focus of the task was to evaluate appropriate alternatives for a ground-water intercept and treatment system, to select the most cost effective alternative for attaining the objective of the IRA, and to identify additional data required to design and implement the IRA.

#### Task 36 -- North Boundary System Component Response Assessment

##### **Objectives**

The objectives of Task 36 were to evaluate the adequacy of the dewatering and recharge components of the North Boundary System through a review of the

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operational data and evaluation of additional geotechnical data; assess the configuration of the Denver Fm sandstones and evaluate their hydrologic characteristics, especially in the area of the Pilot System, through the acquisition and evaluation of additional geologic and hydrologic data; assess the physical condition of the soil-bentonite barrier through in-situ and laboratory testing, especially in areas suspected of having problems, which consider physical and chemical degradation of the wall; and assess the adequacy of the carbon-adsorption type treatment system to effectively remove contaminants to appropriate cleanup goals through the analysis of effluent water samples.

### **Scope-of-Work**

Task 36 characterized the geologic regime in the vicinity of the NBCS using data from previous investigations and additional data collected as part of this task. Where historical data was lacking, soil borings were drilled and soil and rock samples collected. Particular attention directed to the areal extent and position of Denver sand units.

In addition to the geologic characterization, a hydrologic evaluation was performed using primarily water level and quality data. Much of these data were collected as part of the regional Water Quantity/Quality Survey (Tasks 4 and 44) and the Boundary Systems Monitoring (Task 25) tasks. To complement the information available from these tasks and fill data deficiencies, the scope-of-work included installation, development, and sampling of new ground-water monitoring wells in selected locations. These efforts resulted in the completion of 19 wells at 11 sites. Of the new wells, 3 were alluvial, 10 first Denver, and 6 second Denver wells. Completions at 7 of the 11 sites were clusters. Additionally, 10 piezometers were installed under the task. As these new wells were completed and developed, they were sampled for water quality parameters to aid in the identification of other locations for which monitoring wells provided valuable information, and they were sampled in coordination with Tasks 25 and 44 sampling events to provide integrated data sets. Some 70 samples were collected.

Using the data described above, an assessment of the hydrologic conditions in the vicinity of the NBCS was performed. This included an assessment of

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both dewatering and recharge components of the NBCS and the hydrologic relationship between saturated portions of the alluvium and the Denver Fm, using such tools as the ground-water management flow model developed by Jim Warner of Colorado State University.

The carbon-adsorption type water treatment plant was evaluated to ensure that contaminants intercepted can be treated to appropriate cleanup goals. This evaluation included the analysis of effluent water samples for water quality. In addition, turbidity tests on the effluent water were conducted to evaluate what effect carbon fines may have on plugging of the recharge wells.

To complete the assessment of the NBCS, the Task 36 scope-of-work included an evaluation of the physical condition, integrity, and hydrologic properties of the soil-bentonite barrier. Samples of the barrier were collected and subjected to both physical and hydrologic testing. This data, in conjunction with results of the geologic and hydrologic assessment, allowed evaluations of the effectiveness of the barrier.

Upon completion of data assessment, conceptual response actions which may enhance system performance were developed and evaluated.

#### Task 38 - Western Tier TCE Study

##### **Objectives**

The objectives of Task 38 were to perform field and literature investigations of the Western Tier of RMA in order to support current litigation between the United States and the State of Colorado; determine the source(s), if any, of trichloroethene (TCE) in the Western Tier of RMA; if a source exists, define the contaminant plume between the source and the RMA boundary; and estimate the present contribution of TCE concentration from RMA to the offpost South Adams County TCE contamination.

##### **Scope-of-Work**

Task 38 included the compilation of all historical information regarding TCE storage and usage in the western third of RMA, sampling of 36 soil borings, installation of 32 ground-water monitoring wells, 2 separate soil gas surveys, a geophysical program, periodic water level measurements from 102



to 150 wells, and several rounds of ground-water sampling. Site 4-6 was also investigated under Task 38 at which 36 soil borings were drilled and 169 samples collected, including 1 soil grab sample and 3 surface water samples.

Petrex static tube soil gas samplers were placed at about 1,000 locations throughout the Western Tier for a soil gas study. For a separate soil gas study, 256 Tracer Research soil gas samples were collected and analyzed for 1,1,1-trichloroethane (TCA), TCE, and tetrachloroethane (PCE). Twenty-seven of these were analyzed for benzene, toluene, ethyl benzene, and xylenes.

Soil samples were analyzed for standard Phase I compounds including volatile and semivolatile organics (GC/MS), ICP metals, and mercury and arsenic (AA). Water samples were analyzed for volatile halogenated organics (GC/CON), volatile aromatic organics (GC/PID), DBCP (GC/ECD), and nitrates (technicon).

#### Task 39 - Offpost RI/FS

##### **Objectives**

The objectives of Task 39 were to conduct a RI/FS and Endangerment Assessment (EA) in the offpost study area and determine contaminant distribution for input to an EA as support for the FS. This task is primarily concerned with ground-water contamination although air, soil/sediment, biota, and surface water will be considered. Product of task will be support for a Record of Decision.

##### **Scope-of-Work**

Thirteen of 29 proposed sites were drilled for the installation of monitoring wells in the offpost area. Geotechnical efforts resulted in the installation of 19 wells. Seventeen were alluvial, 1 first Denver, and 1 second Denver completions. One cluster site was utilized. Two sampling events were conducted and the samples analyzed. Surface water, soils, and sediments were sampled during the investigation.

Based upon the results of the sample analyses during the RI, an EA and FS were conducted. The FS was oriented toward protection of human health and the environment by remediation of contaminated ground water.

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Task 42 - North Plants Survey**Objectives**

The objectives of Task 42 were to:

- o Assess whether soil or ground water had been contaminated by North Plants operations;
- o Identify the constituents present; and
- o Conduct a preliminary evaluation of the vertical and horizontal extent of contamination, if present.

**Scope-of-Work**

The emphasis of the task was on soils, however six alluvial ground-water monitoring wells were also installed. Ground-water samples were collected and analyzed for volatile aromatics, volatile halogens, semivolatiles, phosphonates, organosulfur compounds, thiodiglycol, cadmium, chromium, copper, lead, zinc, arsenic, mercury, magnesium, calcium, sodium, potassium, sulfate, nitrate, chloride, fluoride, and phosphate.

Task 44 - RMA Onpost/Offpost Ground Water/Surface Water Monitoring Program**Objectives**

As part of the environmental investigation at RMA, the necessity of establishing a litigation-quality data base for surface and ground water has been recognized. Task 4 addressed part of this need by providing baseline data to assess contaminant distributions at RMA.

Under Task 4, three rounds of water samples were collected over a 1-year period within RMA to achieve the following objectives:

- o Satisfy the requirements under CERCLA and the substantive requirements of all applicable or relevant and appropriate Federal and State requirements that have application through CERCLA;
- o Confirm the existence and chemical nature of contamination and monitor any changes in the lateral and vertical extent of contamination; and
- o Develop a core data base for use in upcoming litigation and RI/FS analyses for RMA.

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Task 44 was developed using the core Task 4 objectives; however, the scope of the task has been broadened to address other salient items that were beyond the scope of Task 4.

The objectives of Task 44 as detailed in the Delivery Order were to:

- o Assess the distribution and concentration levels of ground-water contaminants and monitor changes in water quality with respect to these contaminants for both the onpost and offpost areas using established contaminant guidance levels;
- o Monitor and evaluate changes in water levels;
- o Evaluate data and recommend program modifications to this or other water monitoring tasks; and
- o Identify areas of significant public exposure by comparison of offpost water quality results with current guidance levels.

In order to satisfy the primary goals of the task, certain ancillary objectives were accomplished. Additionally, these efforts further defined the Task 44 scope-of-work:

- o Utilize available geologic data to further define the current understanding of the geologic conditions present at RMA;
- o Summarize the hydrogeologic conditions in the onpost and offpost areas by integrating existing hydrologic, geologic, and water quality data;
- o Assess the distribution of contaminants in aqueous media and identify the primary hydrogeologic pathways by which contaminants are being transported to the RMA boundary or the offpost area;
- o Evaluate the existing monitoring program for data deficiencies and assess the need for additional wells; and
- o Integrate all data from water related tasks and supply appropriate information to Task 23 efforts including data bases, contaminant plume maps, and hydrogeologic assessments.

Task 44 established the hydrologic core data base for and provided to the EA and FS groups adequate interpretation and characterization of hydrologic, geologic, and geochemical data so that their specified goals were achieved.

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The overall Task 44 program was designed to be dynamic in nature and was modified, as required, in response to ongoing data evaluation and/or changes in the scope-of-work or task objectives. Task 44 formed the base or trunk hydrologic program, while other efforts (Tasks 25, 36, 38, 39, etc.) were tributary or branch efforts which satisfied specific individual task needs, as well as augmented the Task 44 program.

In addition to 27 square miles (sq mi) of onpost area covered by Task 44, 14 sq mi of the offpost area were monitored. The offpost area extends northwestward from RMA to the South Platte River. Several other detailed ground-water tasks address localized areas within the Task 44 study area.

#### **Scope-of-Work**

The purpose of this task was to perform a hydrologic assessment of the RMA onpost and offpost areas. This assessment included development of a baseline program for hydrologic and contamination surveillance. Network design was followed by collection of surface water and ground-water samples, measurement of hydrologic parameters, and chemical analysis of water samples. These data were evaluated to document the extent of contamination, the hydrologic and geologic conditions of the site, areas of public health exposure, potential contaminant migration pathways, and areas where additional data are required.

The scope of the Task 44 water quantity/quality survey included completing a semiannual and/or quarterly ground-water and surface water monitoring program capable of satisfying the various regulatory requirements, developing litigation-quality data to be added to the current data base, and assessing the extent and nature of contamination. In order to achieve these objectives, work in six distinct technical areas was anticipated. These areas are as follows:

- o Review the historical data;
- o Develop a monitoring program to achieve the objectives in Section 1.2 of the Task 44 Technical Plan;
- o Execute the monitoring program utilizing litigation-quality sampling and analytical procedures;
- o Assess data after the first sampling event for possible adjustments in the sampling and/or analytical scheme;

- o Compile and interpret the accumulated data at the end of the sampling program;
- o Coordinate with and integrate data from other current ground-water tasks such as Tasks 25, 26, 36, 38, and 39; and
- o Identify data gaps and, when possible, rectify.

In the performance of the task, 21 wells were installed at 10 of the 20 proposed sites. Resulting from these efforts was the completion of 4 alluvial, 9 first Denver, and 8 second Denver wells. Seven clusters were completed.

#### Additional Water Related Programs

Included as part of various soil investigation tasks scope-of-work was the requirement for hydrologic monitoring at selected source areas. Under these efforts, water quality and hydraulic monitoring was performed at existing or newly installed ground-water wells in order to determine potential soil/water interactions. Activities as described were conducted under Tasks 1, 19, and 21.

#### 1.2 COMPOSITE WELL PROGRAM (CWP)

As detailed in the Task 44 Technical Plan (ESE, 1988, RIC#88063R11), one of the ancillary objectives of the task was to coordinate the hydrologic activities performed under various RI/FS efforts. A major component of the task was the installation and/or replacement of monitoring wells. Currently, some 200 alluvial and Denver aquifer wells at 120 sites have been proposed under Tasks 1, 19, 21, 25, 36, 39, and 44. As detailed previously, with the exception of the Task 44, a regional activity, the other programs are localized and as such possess site specific requirements. Under this scheme, the potential for duplication of efforts in some areas, while other areas are overlooked, becomes possible. In order to circumvent these potential problems and to maximize resources while minimizing schedule, the Composite Well Program (CWP) was established under Task 44. As such, the CWP evaluated the task specific needs with respect to the overall RMA hydrologic assessment to ensure all requirements for the respective tasks were fulfilled, as well as making sure data gaps in the regional scheme were satisfied.

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As designed, the CWP represents a compilation of all proposed well installation activities for the following tasks:

- o Task 1;
- o Task 11;
- o Task 19;
- o Task 21;
- o Task 22;
- o Task 25;
- o Task 26;
- o Task 36;
- o Task 38;
- o Task 39;
- o Task 42; and
- o Task 44.

#### 1.2.1 CRITERIA

The primary criterion for determining the need for additional wells was based on an evaluation of task objectives and the data required to achieve these. Following development of the respective Technical Plans, an evaluation of the available data versus required data to satisfy task objectives was performed. Where data gaps existed, wells were proposed to provide the necessary information. These gaps included the need for additional:

- o Geologic;
- o Hydrologic;
- o Contaminant Characterization; or
- o Plume Definition Data.

Once the requirement for additional wells was established the study area of the task was evaluated based on its geology, hydrology, contaminant characterization and distribution, and the condition of the existing wells in the area. These evaluations required compilation and analysis of:

- o Cross sections;
- o Isopach maps;
- o Water table elevations;
- o Ground-water flow directions;
- o Saturated thickness;

- o Bedrock surface;
- o Alluvial thickness;
- o Contaminant distribution; and
- o Well construction data.

Following completion of the above evaluations, well sites were proposed. The proposed well locations are illustrated in Plate 1.

The current status of the CWP is detailed in Appendix C.

#### 1.2.2 INSTALLATION PRIORITY

In order to optimally perform the extensive well installation program compiled under the CWP, a priority system utilizing a phased approach was established. The scheme was designed to categorize each well or corehole based on its contribution to satisfying primary task objectives. Installations deemed essential to the achievement of the task were designated as primary and were completed initially. Wells and coreholes defined as secondary are installations which may be more effectively undertaken following an evaluation of the geologic and hydrologic data obtained through completion of the primary sites. Tertiary installations are those which may be drilled, if deemed necessary, following a review of the data collected through completion of the primary and secondary sites. Appendices A and B present the priority rationale for the proposed sites.

The CWP is designed to be dynamic in nature and will be modified as the ongoing geologic, hydrologic, and contamination assessments warrant. Based on continuing data review, assigned priorities may change and/or installations may be eliminated from the program.

## 2.0 TASK 1

### 2.1 OBJECTIVES

Phase I soils data indicate that a relationship may exist between chemical levels in the unsaturated zone and observed levels of these same compounds in downgradient ground water. These relationships may be particularly important and complex where a body of soil containing chemicals exists immediately above and possibly within the saturated zone. Site 36-1 (Basin A) and Sites 36-3, 36-4, and 36-17 are the best examples of this situation. Phase I soil boring data from these sites indicate high levels of arsenic, mercury, pesticides, and munitions. Existing water data also suggest elevated analyte concentrations in downgradient locations.

The proposed plan for installation of monitoring wells in Section 36 has several objectives derived from Task 1 and Task 4. These objectives can be briefly stated as:

- o Providing monitoring points required to investigate the possible contributions to ground-water contamination from Sites 36-1, 36-3, 36-4, and 36-17;
- o Establishing control points for the measurements of ground-water levels and chemical constituents in the eastern third of Section 36; and
- o Defining geology and hydrology in poorly characterized areas which may be significant migration pathways.

All of these objectives support the upcoming effort to combine and correlate soil and ground-water data already obtained. Monitoring wells will be sited based on Phase I data in order to monitor upgradient and downgradient conditions at sites. Wells will be placed to best advantage to investigate ground-water flow patterns and the possible presence of bedrock channels which have been suggested through previous geologic mapping.



## 2.2 PROPOSED LOCATIONS

### Site EP-35

**Location:** Proposed well site EP-35 is located 100 feet (ft) north of the south line, 680 ft east of the west line in Section 36, T2S R67W.

**Rationale:** The proposed well will replace existing Well 36001. The approximate location is Basin A (Site 36-1) upgradient alluvial, intermediate, and lower aquifer characterization. Existing Well 36001, of undocumented construction, exhibits high contaminant concentrations potentially related to the South Plants area ground-water contamination, surface runoff, or leakage from the contaminated sewer. These wells will complement additional shallow wells along the section line which have been proposed by Task 26.

### Site EP-36

**Location:** Proposed well site EP-36 is located 200 ft north of the south line, 3,000 ft east of the west line in Section 36, T2S, R67W.

**Rationale:** Insecticide Pits (Site 36-3) upgradient alluvial aquifer characterization. Site EP-36 is located to supplement Well 36075, which is rated as questionable construction. The well will screen the entire saturated alluvium which is approximately 10-ft thick in this area.

### Site EP-37

**Location:** Proposed well site EP-37 is located 1,750 ft north of the south line, 2,450 ft west of the east line in Section 36, T2S, R67W.

**Rationale:** Mustard Disposal Area (Site 36-17) downgradient alluvial aquifer characterization. Site EP-37 will determine the presence of mustard degradation products.

### Site EP-38

**Location:** Proposed well site EP-38 is located 2,450 ft south of the north line, 2,350 ft west of the east line in Section 36, T2S, R67W.

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**Rationale:** Reactor Vessel Area (Site 36-17) downgradient alluvial aquifer characterization. Site EP-38 will determine the presence of contaminants due to upgradient reactor vessel disposal. The site is located to supplement Well 36084 which is of questionable construction. The saturated alluvium is approximately 15-ft thick in this area, so the screen length will be 17 ft.

Site EP-39

**Location:** Proposed well site EP-39 is located 2,605 ft north of the south line, 1,900 ft west of the east line in Section 36, T2S, R67W.

**Rationale:** Reactor Vessel Area (Site 36-17) upgradient alluvial aquifer characterization. Site EP-39 will determine upgradient water quality in the area of Basin A. The screen length will be 12 ft as the saturated alluvium is approximately 10-ft thick.

Site EP-41

**Location:** Proposed well site EP-41 is located 1,500 ft south of the north line, 400 ft east of the west line in Section 36, T2S, R67W. Additionally, the well is 100 ft east of Well 36017.

**Rationale:** Basin A (Site 36-1) downgradient alluvial, intermediate, and lower aquifer characterization. Site EP-41 will be along the Basin A outflow, and will supplement many poorly documented wells in this area.

### 3.0 TASK 11

#### 3.1 OBJECTIVES

The objective Task 11 was to conduct a contamination survey of the soil and ground water in the vicinity of the Hydrazine Blending Storage Facility (HBSF) and provide information necessary to assess the nature and extent of contamination in the HBSF. This information was utilized in the general assessment of contamination at RMA overseen by PMO, and in the more specific context of Task 13, which includes a Resource Conservation and Recovery Act (RCRA) closure plan for the HBSF. The Task 11 Technical Plan was developed to provide pertinent information for (1) the preparation of a RCRA closure plan, which requires continued ground-water monitoring, and (2) the overall assessment of the extent of contamination at RMA.

The initial portion of the Task 11 work program was an extensive literature review to develop a complete history of the activities at the HBSF and of previous studies. Data obtained from this literature review details the physical, chemical and environmental histories of the HBSF. This information was used to support a geotechnical program which evaluated existing ground-water monitoring and soils sampling networks with respect to the requirements of a RCRA closure plan.

Water levels were measured in the existing monitoring wells located within 500 ft of the HBSF. This information was incorporated into the Task 11 study to develop preliminary information on flow patterns in the shallow ground-water system. By incorporating the ten existing wells into the closure plan, the HBSF was surrounded with monitoring wells both upgradient and downgradient of the source. Two additional wells within HBSF were required to monitor the ground water beneath the potential source. Ground-water flow patterns along with the semiquantitative results of the soil boring program were used to determine the locations of the two new wells proposed for installation at the HBSF under Task 11.

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### 3.2 PROPOSED LOCATIONS

#### Site\_HSBF-1

**Location:** Proposed well site HSBF-1 is located 480 ft south of the north line and 1,450 ft west of the east line of Section 1, T3S, R67W.

**Rationale:** Required to satisfy regulatory monitoring requirements.

#### Site\_HSBF-2

**Location:** Proposed well site HSBF-2 is located 400 ft south of the north line and 250 ft west of the east line of Section 1, T3S, R67W.

**Rationale:** Required to satisfy regulatory monitoring requirements.

## 4.0 TASK 19

### 4.1 OBJECTIVES

Phase I soils data indicate that a relationship may exist between chemical levels in the unsaturated zone and observed levels of these same compounds in downgradient ground water. These relationships may be particularly important and complex where a body of soil containing chemicals exists immediately above and possibly within the saturated zone. Basins B through F (Sites 35-3, 26-3, 26-4, 26-5, and 26-6) are examples of this situation.

The proposed plan for installation of monitoring wells in Sections 26 and 35 has several objectives. These objectives can be briefly stated as:

- o Providing monitoring points required to investigate the possible contributions to ground-water contamination from Sites 35-3, 26-3, 26-4, 26-5, and 26-6;
- o Establishing control points for the measurements of ground-water levels and chemical constituents in Section 26 and the northeastern part of Section 35;
- o Defining the paleotopographic surface of the bedrock, the geology, and the hydrology in poorly characterized areas; and
- o Defining the vertical extent of analytes in Section 26 and the northeast quarter of Section 35.

All of these objectives support the upcoming effort to combine and correlate soil and ground-water data already obtained. Monitoring wells have been sited based on Phase I data in order to monitor upgradient and downgradient conditions at sites. Wells have been carefully placed to investigate ground-water flow patterns and the possible presence of bedrock channels which have been suggested through previous geologic mapping. The elevation and paleotopography of the underlying bedrock surface will also be investigated.

### 4.2 PROPOSED LOCATIONS

#### Site EP-42

Location: Proposed well site EP-42 is located 375 ft south of the north line, 1,400 ft west of the east line, Section 35, T2S, R67W.

**Rationale:** Basin B (Site 35-3) downgradient alluvial aquifer characterization. Site EP-42 will be located to establish water quality beneath Basin B. The water table occurs approximately 10 to 15 ft below ground surface. The screen will be placed at the water table in the saturated alluvial material. It is anticipated that this well will correlate with Wells 35044 and 35046 which are completed in the upper Denver Fm.

Site EP-43

**Location:** Proposed well site EP-43 is located 800 ft north of the south line, 1,300 ft west of the east line, Section 26, T2S, R67W.

**Rationale:** Basin C (Site 26-3) upgradient water table aquifer characterization. Site EP-43 will be located east of the basin boundary to establish water quality in the area of Basin C. The water table occurs at or slightly above the bedrock surface, or approximately 30 ft below ground surface. The screened interval will be within the saturated, fractured clayshale unit at the top of the Denver Fm. Wells in this area (26057, 26058, 26063, 26064, 26096) are all screened in the upper or lower Denver sands and do not reflect alluvial aquifer characteristics.

Site EP-44

**Location:** Proposed well site EP-44 is located 200 ft north of the south line, 2,500 ft east of the west line, Section 26, T2S, R67W.

**Rationale:** Basin D (Site 26-4) upgradient, and Basins B and C (Sites 35-3 and 26-3) downgradient alluvial and Denver aquifer characterization. The alluvial well will be screened below the water table in the fractured clayshale at the alluvium/bedrock contact. Based on well log 26060, the lower Denver sand is anticipated to occur in the 80- to 100-ft interval. A lower zone will also be screened to determine the vertical extent of contamination. No well logs are available which extend below the lower sand of the Denver Fm. Total depth of this well will not exceed 150 ft.

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Site EP-45

**Location:** Proposed well site EP-45 is located 1,200 ft north of the south line, 1,550 ft east of the west line, Section 26, T2S, R67W.

**Rationale:** Basin D (Site 26-4) downgradient water table aquifer characterization. Site EP-45 will be located in the northwest corner of Basin D to establish water quality downgradient of the basin. The water table occurs at or slightly below the bedrock surface, or approximately 30 ft below ground surface. This well will be screened in the fractured clayshale of the upper Denver Fm. Site EP-45 will correlate with strata penetrated by Wells 26005 and 26068.

Site EP-46

**Location:** Proposed well site EP-46 is located 950 ft north of the south line, 800 ft east of the west line, Section 26, T2S, R67W.

**Rationale:** Basin E (Site 26-5) upgradient water table aquifer characterization. Site EP-46 will be located immediately southeast of the basin boundary to establish water quality upgradient of Basin E. The water table occurs approximately 5 ft above the bedrock surface and approximately 30 ft below ground surface. The screened interval will be within the saturated, fractured clayshale unit at the top of the Denver Fm. Site EP-46 will correlate with Well 26068, which is completed in the Denver Fm. No adjacent alluvial wells exist which characterize the alluvial aquifer upgradient of Basin E.

Site EP-47

**Location:** Proposed well site EP-47 is located 1,750 ft north of the south line, 50 ft west of the east line, Section 27, T2S, R67W.

**Rationale:** Basin E (Site 26-5) downgradient water table aquifer characterization. Site EP-47 will be located in the west of Basin E to establish water quality downgradient of the basin. The water table occurs approximately 5 ft above the bedrock surface, or 25 ft below ground surface.

This well will be screened in the fractured clayshale of the uppermost Denver Fm. A well at this location will provide a control point for geology and water level fluctuations in the basin.

Site EP-48

**Location:** Proposed well site EP-48 is located 2,350 ft south of the north line, 1,400 ft east of the west line, Section 26, T2S, R67W.

**Rationale:** Basin F (Site 26-6) downgradient water table aquifer characterization. Site EP-48 will be located in Basin F along the western boundary to establish water quality below the basin. The water table occurs at the bedrock contact, or approximately 40 to 50 ft below ground surface. This well will be screened at the water table in the fractured clayshale of the uppermost Denver Fm.

Site EP-49

**Location:** Proposed well site is adjacent to Wells 26140, 26141, and 26142, and located 2,400 ft south of the north line, 1,500 ft west of the east line, Section 26, T2S, R67W.

**Rationale:** Basin F (Site 26-6) upgradient water table aquifer characterization. Site EP-49 will be located southeast of the basin boundary to establish water quality upgradient of Basin F. The water table occurs at the bedrock contact, or approximately 48 ft below ground surface. This well will be screened at the water table in the fractured clayshale of the uppermost Denver Fm. This well will correlate with Wells 26140 and 26127.

Site EP-50

**Location:** Proposed well site EP-50 is located 550 ft south of the north line, 800 ft east of the west line, Section 26, T2S, R67W.

**Rationale:** Section 26 downgradient water table and Denver aquifer characterization. This well cluster will be used to determine the vertical extent of organic and inorganic analytes downgradient of Basins A through F.



These wells will correlate with well clusters in Section 23 (23179, 23180, 23181; 23185, 23186, 23187; 23191, 23192, 23193) and will supplement Wells 26145, 26146, and 26147 which are of questionable construction.

The water table occurs approximately 40 ft below ground surface near the alluvium/bedrock contact. The alluvial well will be screened below the water table in the fractured clayshale at the top of the Denver Fm. Based on the log for bore number 1137, the lower sand occurs between 85 to 105 ft. A lower zone will also be screened to determine the vertical extent of contamination. Total depth of this well will not exceed 150 ft.

Site EP-52

**Location:** Proposed well site EP-52 is located 900 ft south of the north line, 1,700 ft west of the east line, Section 26, T2S, R67W.

**Rationale:** Section 26 alluvial and Denver aquifer characterization. The cluster will provide the hydrologic and water quality data to characterize and define contaminant migration out of Basin F toward the NBCS. In addition, the site will provide geologic information regarding the subsurface structure in the area. Existing wells in the area are of undocumented construction and further necessitate the installation of the well cluster.

Site EP-59

**Locations:** Proposed well site EP-59 is located 2,100 ft north of the south line, 2,000 ft east of the west line, Section 26, T2S, R67W.

**Rationale:** Basin C (Site 26-3) downgradient water table aquifer characterization. Site EP-59 will be located in the northwest portion of Basin C to establish water quality downgradient of the basin. The water table occurs at or slightly above the bedrock surface, or approximately 33 ft below ground surface. This well will be screened in the fractured clayshale of the upper Denver Fm.

## 5.0 TASK 21

### 5.1 OBJECTIVES

Phase I soils data from borings in Sections 25 and 30 indicate the presence of above background levels of arsenic (up to 50 ppm) in the soil. Arsenic has not been found in ground water in existing wells in this area in either the alluvial or the Denver aquifers at the present time or during past studies.

Few wells exist in the eastern half of Section 25 or throughout Section 30. For this reason, the paleotopographic surface of the bedrock and the thickness of the saturated alluvium are not clearly defined. Several bedrock channels have been hypothesized throughout these sections; however, their exact locations are not clearly delineated. The elevation of the water table throughout this area and how the water table interacts with First Creek are also unclear at this time.

The proposed plan for installation of piezometer nests and monitoring wells in Sections 25 and 30 has several objectives derived from Task 14. These objectives can be briefly stated as:

- o Determining the impact of high arsenic values detected within soil borings in the eastern half of Section 25 on ground water quality;
- o Defining the paleotopographic surface of the bedrock, the geology, and the hydrology in the vicinity of First Creek; and
- o Installing a piezometer nest and recorder to determine alluvial aquifer vertical hydraulic gradients in the vicinity of the Section 30 surface water gaging station on First Creek.

All of these objectives support the upcoming effort to combine and correlate soil and ground water data already obtained. Monitoring wells have been sited based on the Phase I boring program and an analysis of hydrologic and geologic data. The piezometer wells will be carefully placed to investigate the interactions between ground water and First Creek, and to complement data collected from existing and proposed monitoring wells.

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The well installation program consists of a total of six sites including five individual monitoring wells and one piezometer nest. All of these wells are intended to augment the regional ground water monitoring network. The purpose and justification for the five regional monitoring wells and the piezometer nest are summarized below.

## 5.2 PROPOSED LOCATIONS

### Site EP-29

**Location:** Proposed well site EP-29 is located 1,100 ft west of east line, 1,200 ft south of north line in Section 25, T2S, R67W.

**Rationale:** Alluvial aquifer characterization. Site EP-29 will be located to delineate the extent of the bedrock valley seen in the wells along the southern edge of Section 36. Bedrock in this area is anticipated to occur 40 ft below ground surface and to be covered by 10 ft of saturated alluvium.

### Site EP-30

**Location:** Proposed well site EP-30 is located 2,000 ft north of the south line, 1,300 ft west of the east line in Section 25, T2S, R67W.

**Rationale:** Alluvial aquifer characterization. Site EP-30 will be located along the deep drainage ditch from North Plants to First Creek. The purposes of this well include determining the impact of high arsenic values found in surrounding soils bores and confirming the elevation of the bedrock paleotopographic surface. Based on Well 25007 (Bore 827), bedrock in this area occurs 40 ft below ground surface and is overlain by 10 ft of saturated alluvium.

### Site EP-31

**Location:** Proposed well site EP-31 is located 2,200 ft south of the north line, 100 ft east of the west line in Section 30, T2S, R67W.

**Rationale:** Alluvial aquifer characterization. Water level measurements from this well will be correlated with data from Sites EP-32, EP-33, and

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EP-34 to determine vertical hydraulic gradients near First Creek. Bedrock in this area is anticipated to occur 15 ft below ground surface and to be overlain by 8 ft of saturated alluvium.

Site EP-32

**Location:** Proposed well site EP-32 is located 2,100 ft south of north line, 300 ft east of west line in Section 30, T2S, R66W.

**Rationale:** Data from Site EP-32 will help to characterize vertical hydraulic gradients in the alluvium and upper Denver Fm. Bedrock in this area is anticipated to occur 15 ft below ground surface. The water table should occur within 5 ft of ground surface in this area. Two piezometers will be located in the saturated alluvium. The upper piezometer will be located in the top half of the saturated zone with the lower piezometer in the bottom half of the zone. A third piezometer will be installed within the upper sand of the Denver Fm. Based on the bore log for Well 30001, the top of the upper sand occurs 20 ft below ground surface. Water level measurements from the piezometer nest will be correlated with data from sites EP-31, EP-33, and EP-34, and with data from the surface water gaging station to determine the vertical hydraulic gradient.

Site EP-33

**Location:** Proposed well site EP-33 is located 2,100 ft south of the north line, 200 ft east of the west line in Section, 30 T2S, R66W.

**Rationale:** Alluvial aquifer characterization. This will be a small diameter well for water level determination. Water level measurements from this well will be correlated with data from sites EP-31, EP-32, and EP-34 to determine vertical hydraulic gradients near First Creek. Bedrock in this area is anticipated to occur 15 ft below ground surface. The water table should occur within 5 ft of ground surface due to the well's proximity to First Creek.

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**Site EP-34**

**Location:** Proposed well site EP-34 is located 2,050 ft south of the north line, 450 east of the west line in Section 30, T2S, R66W.

**Rationale:** Alluvial aquifer characterization. Water level measurements from this well will be correlated with data from sites EP-31, EP-32, and EP-33 to determine vertical hydraulic gradients near First Creek. Bedrock in this area is anticipated to occur 15 ft below ground surface. The water should occur within 5 ft of ground surface.

## 6.0 TASK 22

### 6.1 OBJECTIVES

The objective of the Phase II surveys is to accurately define the degree and geometry of potential contamination found present during the Phase I surveys conducted under Task 15.

One well is proposed for the Phase II survey at Site 5-2. One boring will be drilled to bedrock and completed as an alluvial monitoring well.

### 6.2 PROPOSED LOCATION

**Location:** Site 5-2, northwest quarter of Section 5, approximately 2,400 ft south of the north section line (December Seventh Avenue) and 150 ft east of the west section line ("F" Street). One alluvial well.

**Rationale:** The proposed well will provide data to better define the geology and water quality in this area, and help determine whether the source site is contaminating the ground water.

## 7.0 TASK 25

### 7.1 OBJECTIVES

Ground-water hydrology and contamination in the areas of the boundary containment systems have been monitored since the late 1970's. Much of the early monitoring was conducted to investigate the contamination problems and to collect design criteria for the boundary containment systems. Following construction and start-up of the NBCS in 1982 and the NWBCS in 1984, formal ground-water monitoring programs were established utilizing monitoring wells that had been installed through the investigative projects. The monitoring programs for both systems required water quality and water level data acquisition and evaluation on a routine basis.

Task 25 continues these earlier efforts and is designed to satisfy the following objectives:

- o Monitor ground-water flow and contaminant transport in and around the boundary containment systems;
- o To define contaminant pathways; and
- o To provide water quality and hydrologic data for the operations of the systems.

In an effort to comprehensively fulfill these task objectives, the need for additional ground-water wells was recognized.

### 7.2 PROPOSED LOCATIONS

#### SITE E-55

**Location:** Proposed well site E-55 is located offpost and downgradient of and within the paleochannel treated by the NWBCS. The approximate location is 1,600 ft east of the west section line and 2,700 ft south of the north section line of Section 22, T2S, R67W.

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**Rationale:** Proposed well site E-55 will aid in the evaluation and location of the Northwest Boundary paleochannel, in mapping bedrock geology, and in preparing water table contour maps. E-55 is also proposed to evaluate the operation of the NWBCS and water quality in the offpost area between the containment system and the proposed wells of South Adams County Water and Sanitation District (SACWSD).

SITE E-66

**Location:** Proposed well site E-66 is located offpost adjacent to Well 37332 along State Route 2. The approximate location is 2,400 ft east of the west section line and 2,200 ft north of the south section line of Section 22, T2S, R67W.

**Rationale:** Proposed well site E-66 will replace Well 36332. The existing well does not screen the entire saturated alluvium. The proposed well will be screened across the top of the water table down to the bedrock contact and provide hydrologic and water quality data offpost and downgradient of the NWBCS to monitor the performance and operation of the system.

SITE E-67

**Location:** Proposed well site E-67 is located offpost adjacent to Well 37334 along Yosemite. The approximate location is 30 ft west of the east section line and 2,500 ft north of the south section line of Section 21, T2S, R67W.

**Rationale:** Proposed well site E-67 will replace existing Well 37334. The existing well does not screen the entire saturated alluvium. The proposed well will be screened across the top of the water table down to the bedrock contact. This well will provide hydrologic and water quality data offpost and downgradient of the NWBCS in an area where contamination has recently been detected.

SITE E-68

**Location:** Proposed well site E-68 is located offpost adjacent to Well 37330 along State Route 2. The approximate location is 1,300 ft east of the west section line and 800 ft north of the south section line of Section 22, T2S, R67W.



**Rationale:** Proposed well site E-68 will replace existing Well 37330. The existing well does not screen the entire saturated alluvium. The proposed well will be screened across the top of the water table and down to the bedrock contact. This well will provide hydrologic and water quality data offpost and downgradient of the NWBCS to monitor its performance and operation.

SITE EP-01

**Location:** Proposed well site EP-01 is located upgradient of the NWBCS. The approximate location is 2,500 ft east of the west section line and 100 ft north of the south section line of Section 22, T2S, R67W.

**Rationale:** EP-01 is a proposed new well to replace existing Well 22008. Existing Well 22008 does not fully penetrate the entire thickness of the saturated alluvium. The proposed well will be screened across the top of the water table down to the bedrock contact and will consequently provide both hydrologic and water quality data for the entire zone of interest. Additionally, the proposed well will aid in the monitoring and definition of contaminant flow paths in the southern portion of the NWBCS in an area of a possible bedrock paleochannel.

SITE EP-01A

**Location:** Proposed well site EP-01A is located upgradient of the NWBCS. The approximate location is 450 ft north of the south section line and 2,600 ft east of the west section line of Section 22, T2S, R67W.

**Rationale:** Proposed well site EP-01A will provide hydrologic and water quality data to further delineate contaminant flow paths and plume definition in the southern portion of the NWBCS. Evaluation of the bedrock geology in the area indicate the presence of a possible paleochannel. Additional information derived from an evaluation of existing wells in the area (Task 25 and Task 4 Technical Plans) indicate these wells to be largely of undocumented construction.

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SITE EP-02

**Location:** Proposed well site EP-02 is located between existing Wells 27005 and 27006. The approximate location is 750 ft east of the west section line and 850 ft south of the north section line of Section 27, T2S, R67W.

**Rationale:** Proposed well site EP-02 will provide hydrologic and water quality data to evaluate water quality exiting RMA south of the NWBCS. The proposed well will monitor the area to ensure that contamination does not migrate around the system. Existing wells in the area are largely of undocumented construction and past evaluations (Task 25 and Task 4 Technical Plans) indicate that the wells do not screen the entire thickness of saturated alluvium.

SITE EP-03

**Location:** Proposed well site EP-03 is located between existing Wells 27010 and 27011. The approximate location is 1,300 ft east of the west section line and 250 ft south of the north section line of Section 27, T2S, R67W.

**Rationale:** Proposed well site EP-03 will provide hydrologic and water quality data to evaluate water quality exiting RMA south of the NWBCS. The proposed well will monitor the area to ensure that contamination does not migrate around the system. Existing wells in the area are largely of undocumented construction and past evaluations (Task 25 and Task 4 Technical Plans) indicate that the wells do not screen the entire thickness of saturated alluvium.

SITE EP-04

**Location:** Proposed well site EP-04 will replace existing Well 23160. The approximate location is 25 ft west of the east section line and 1,700 ft south of the north section line in Section 22, T2S, R67W.

**Rationale:** Proposed well site EP-04 will provide the hydrologic and water quality data to better define contaminant transport in the center portion of the plume treated by the NBCS. An evaluation of existing Well 23160 indicates that it does not fully screen the entire thickness of saturated alluvium. Proposed well site EP-04 will be screened across the interval

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from the top of the water table to the bedrock contact and consequently provide data which will fully characterize contaminant transport at the plume center.

#### SITE EP-05

**Location:** Proposed well site EP-05 will replace existing Well 23013. The approximate location is 1,800 ft west of the east section line and 2,800 ft north of the south section line of Section 23, T2S, R67W.

**Rationale:** Proposed well site EP-05 will provide the hydrologic and water quality data to better delineate the lateral contaminant extent of the plume treated by the NBCS. An evaluation of existing Well 23013 indicates that it does not fully screen the entire thickness of saturated alluvium. Proposed well site EP-05 will be screened across the interval from the top of the water table to the bedrock contact and consequently provide data which will aid in the lateral definition of the plume.

#### EP-06

**Location:** Proposed well site EP-06 will replace existing Well 23106. The approximate location is 500 ft west of the east section line and 1,450 ft north of the south section line of Section 23, T2S, R67W.

**Rationale:** Proposed well site EP-06 will provide the hydrologic and water quality data to better define lateral contaminant distribution in the plume treated by the NBCS. An evaluation of existing Well 23106 indicates that it does not fully screen the entire thickness of saturated alluvium. Proposed well site EP-06 will be screened across the interval from the top of the water table to the bedrock contact and consequently provide data which will aid in delineation of contaminant distribution across the plume.

#### EP-07

**Location:** Proposed well site EP-07 will replace existing well site 24162. The approximate location is 700 ft east of the west section line and 100 ft south of the north section line in Section 24, T2S, R67W.

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**Rationale:** Proposed well site EP-07 will provide hydrologic and water quality data downgradient of the NBCS. Existing Well 24162 does not screen the entire thickness of saturated alluvium. Proposed well site EP-07 will be screened across the interval from the top of the water table to the bedrock contact and provide data for the entire zone of interest.

SITE EP-08

**Location:** Proposed new well site EP-08 will replace existing Well 24180. The approximate location is 1,800 ft east of the west section line and 500 ft south of the north section line of Section 24, T2S, R67W.

**Rationale:** Proposed new well site EP-08 will provide hydrologic and water quality data immediately upgradient of the NBCS slurry wall. Existing Well 24180 does not fully screen the entire thickness of saturated alluvium. The new well will be screened across the water table and down to the bedrock contact and provide data for the entire zone of interest.

SITE EP-09

**Location:** Proposed new well site EP-09 will replace existing Well 24181. The approximate location is 2,050 ft east of the west section line and 500 ft south of the north section line of Section 24, T2S, R67W.

**Rationale:** Proposed new well site EP-09 will provide hydrologic and water quality data immediately upgradient of the NBCS slurry wall. Existing Well 24181 does not screen the entire thickness of alluvium. The new well will be screened across the water table and down to the bedrock contact and provide data across the entire zone of interest.

SITE EP-10

**Location:** Proposed new well site EP-10 will replace existing Well 24182. The approximate location is 2,750 ft west of the east section line and 550 ft south of the north section line of Section 24, T2S, R67W.

**Rationale:** Proposed new well EP-10 will provide hydrologic and water quality data immediately upgradient of the NBCS slurry wall. Existing Well 24182 does not screen the entire thickness of alluvium. The new well will

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be screened across the water table and down to the bedrock contact and provide data across the entire zone of interest.

SITE EP-11

**Location:** Proposed well site EP-11 will replace existing Well 24115. The approximate location is 1,850 ft east of the west section line and 1,500 ft south of the north section line of Section 24, T2S, R67W.

**Rationale:** Proposed new well EP-11 will provide hydrologic and water quality data upgradient of the NBCS dewatering wells. Existing Well 24115 does not screen the entire thickness of saturated alluvium. The new well will be screened across the water table and down to the bedrock contact and will provide data across the entire zone of interest.

SITE EP-12

**Location:** Proposed new well site EP-12 will replace existing Well 24106. The approximate location is 1,300 ft west of the east section line and 1,500 ft south of the north section line of Section 24, T2S, R67W.

**Rationale:** Proposed new well EP-12 will provide hydrologic and water quality data upgradient and east of the NBCS to aid in the definition of the lateral extent of contaminant migration. Existing Well 24106 does not screen the entire thickness of saturated alluvium. The new well will be screened across the water table and down to the bedrock contact and provide data across the entire zone of interest.

SITE EP-13

**Location:** Proposed new well site EP-13 will replace existing Well 24113. The approximate location is 1,100 ft east of the west section line and 2,000 ft south of the north section line of Section 24, T2S, R67W.

**Rationale:** Proposed new well EP-13 will provide hydrologic and water quality data upgradient of the plume treated by the NBCS and augment plume characterization. Existing Well 24113 does not screen the entire thickness of the alluvium. The new well will be screened across the water table and

down to the bedrock contact and provide data across the entire zone of interest.

SITE EP-14

**Location:** Proposed new well site EP-14 will replace existing Well 24008. The approximate location is 400 ft east of the west section line and 2,300 ft south of the north section line of Section 24, T2S, R67W.

**Rationale:** Proposed new well EP-14 will provide hydrologic and water quality data upgradient of the NBCS to augment plume characterization and definition. Existing Well 24008 does not screen the entire thickness of saturated alluvium. The new well will be completed from above the water table down to the bedrock contact and provide data across the entire zone of interest.

Site EP-16

**Location:** Proposed new well site EP-16 will replace existing Well 24010. The approximate location is 400 ft east of the west section line and 1,100 ft north of the south section line of Section 24, R2S, R67W.

**Rationale:** Proposed new well EP-16 will provide hydrologic and water quality data for the contaminant plume between the North Plants and Basin F and the NBCS to further define and characterize it. Existing Well 24010 does not screen the entire thickness of the saturated alluvium. The new well will be screened from above the water table down to the bedrock contact and provide data across the entire zone of interest.

SITE EP-17

**Location:** Proposed new well site EP-17 is located downgradient of the sewage treatment plant and pond. The approximate location is 2,708 ft east of the west section line and 2,000 ft south of the north section line of Section 24, T2S, R67W.

**Rationale:** Proposed well site EP-17 will define and delineate any possible contamination originating from the sewage treatment plant and lagoon, and/or North Plants to the NBCS. There are no existing wells in the vicinity. The

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closest upgradient wells are located over 1,100 ft away and downgradient wells within 900 ft of this site are of largely undocumented construction. The proposed well will be screened from above the water table down to the bedrock surface.

#### SITE EP-18

**Location:** Proposed well site EP-18 is located downgradient of the North Plants and upgradient of the NBCS. The approximate location is 2,000 ft west of the east section line and 1,400 ft north of the south section line of Section 24, T2S, R67W.

**Rationale:** The proposed well site will fill in a gap in the existing monitoring network as there are no existing wells in the vicinity. The proposed well will provide hydrologic and water quality data to augment contaminant characterization and plume delineation along migration pathways originating from the North Plants. Subsurface evaluation indicates a possible paleochannel in the area. Wells located upgradient between this site and the North Plants are largely of undocumented construction while the closest acceptable downgradient well is over 1,000 ft away. The well will be screened from above the water table down to the bedrock surface.

#### SITE EP-23

**Location:** Proposed well site EP-23 is located upgradient of the North Boundary Pilot System (NBPS). The approximate location is 700 ft west of the east section line and 1,700 ft south of the north section line of Section 23, T2S, R67W.

**Rationale:** Proposed well site EP-23 is located upgradient of the NBPS and will provide hydrologic data to determine plume flow directions as well as water quality information for contaminant characterization. In addition, wells within 500 ft of the site are of undocumented construction. The proposed well will be screened from above the water table down to the bedrock contact.

## 8.0 TASK 26

### 8.1 OBJECTIVES

The objectives of Task 26 were to evaluate the ground-water flow systems in the South Plants, Basin A, and Basin A Neck region; to identify areas in this region for implementing IRAs, and, to prepare an assessment of alternatives for the design and construction of an alluvial ground-water intercept and treatment system in the Basin A Neck area.

The focus of the task has been revised twice. Originally a feasibility study evaluating the ground-water flow systems and developing conceptual ground-water collection and treatment systems for the South Plants and Basin A areas, the task was changed to an Alternatives Assessment for an IRA in the Basin A Neck area. The focus of the task was to evaluate appropriate alternatives for a ground-water intercept and treatment system, to select the most cost effective alternative for attaining the objective of the IRA, and to identify additional data required to design and implement the IRA.

### 8.2 PROPOSED LOCATIONS

#### Site S-1

**Location:** Proposed well S-1 is located 400 ft north of the south line and 1,900 ft west of the east line of Section 35, T2S, R67W.

**Rationale:** Well S-1 will be installed in the Denver aquifer as an addition to an existing well cluster consisting of Wells 35052, 35053, and 35054. This well will aid in defining the sand channel located west of Basin A.

#### Site S-2, 3, 4

**Location:** Well S-2, 3, 4 is located 1,200 ft south of the north line and 2,400 ft west of the east line of Section 35, T2S, R67W.

**Rationale:** The wells will be installed in the Basin A neck area into the various Denver sands in the region and will aid in determining the



interaction between the various units. The wells will also assist in identifying the existence and location of the inactive fault zone.

Site S-5, 6, 7, 8

**Location:** Site 3-5, 6, 7, 8 is located 400 ft south of the north line and 1,200 ft west of the east line of Section 35, T2S, R67W.

**Rationale:** Wells S-5, S-6, S-7, and S-8 will be installed as a cluster along the fault northwest of Basin A Neck. This location is approximately on the axis of the Basin A Neck. The wells will penetrate the alluvium and the three major Denver sands found beneath the site. These wells will help describe the influence of the inactive fault on ground-water flow. They will also allow chemical characterization of the respective alluvial and Denver units.

Site S-9, 10, 11

**Location:** Site S-9, 10, 11 is located 2,100 ft north of the south line and 300 ft east of the west line of Section 35, T2S, R67W.

**Rationale:** A cluster of wells, Wells S-9, S-10, and S-11, will be installed on the western region of Basin A where it is suspected that the Upper Denver sand unit subcrops and is in contact with the alluvium. Well S-9 will be installed in the alluvium, Well S-10 in the subcropping sand unit, and Well S-11 in a lower Denver sand unit. These wells will aid in defining the location of the Denver sand channels west of Basin A and in determining the interactions between the Denver and the alluvium.

Site S-12

**Location:** Site S-12 is located 100 ft north of the south line and 1,400 ft east of the west line of Section 36, T2S, R67W.

**Rationale:** Well S-12 will be installed in the alluvium between South Plants and Basin A to monitor the movement of ground water and contaminants towards Basin A.

Site S-13, 14

**Location:** Site S-3, 14 is located 300 ft north of the south line and 500 ft west of the east line of Section 35, T2S, R67W.

**Rationale:** Wells S-13 and S-14 will be installed next to Wells 71 and 72 immediately northwest of South Plants in Section 35. Well 71 is installed in the upper Denver sand unit and will be used to monitor a pumping test that will be conducted using Well S-13, which will also penetrate this unit. A single pair of piezometers will be installed near Well S-13. These will be installed in the Denver shale, below the water table but above the upper Denver sand. The piezometers will be used to monitor the response, if any, of the shale unit to the pump test. Well 72 is installed in the lower Denver sand unit and Well S-14 will be installed in the intermediate Denver sand unit associated with the coal seam. Environmental Science and Engineering, Inc. (ESE) has reported problems sampling this well. If these problems cannot be corrected, another well may be installed to provide chemical data and flow characteristics of the lower Denver sand unit.

Site S-15

**Location:** Site S-15 is located 2,000 ft north of the south line and 1,300 ft east of the west line of Section 3, T3S, R67W.

**Rational:** Site S-15 will be installed in the alluvium next to the lakes to provide information which will assist in an analysis of ground-water/surface water interactions.

Site S-16

**Location:** Site S-16 is located 800 ft north of the south line and 100 ft east of the west line of Section 1, T3S, R67W.

**Rationale:** Site S-16 will be installed in the alluvium next to the lakes to provide information which will assist in an analysis of ground-water/surface water interactions.

Site S-17

**Location:** Site S-17 is 1,900 ft west of the east line and 1,500 ft north of the south line of Section 1, T3S, R67W.

**Rationale:** Site S-17 will be installed in the alluvium next to the lakes to provide information which will assist in an analysis of ground-water/surface water interactions.

Site S-18

**Location:** Site S-18 is located 1,700 ft north of the south line and 800 ft west of the east line of Section 1, T3S, R67W.

**Rationale:** Site S-18 will be installed in the alluvium next to the lakes to provide information which will assist in an analysis of ground-water/surface water interactions.

## 9.0 TASK 36

### 9.1 OBJECTIVES

Task 36 is designed to assess the performance of the NBCS. In order to perform such an investigation, two basic objectives must be satisfied:

- o Address the potential of Denver Formation sandstones in the area of the NBCS to act as conduits for contaminant transport.
- o Determine the adequacy of the present dewatering, recharge, and soil-bentonite barrier system to effectively mitigate the migration of alluvial contamination across the RMA North Boundary.

The successful accomplishment of these task objectives (primarily the Denver sands assessment) will require the installation of additional wells in the NBCS area.

The specific sites for the task have been chosen after extensive review of the local geology and of existing hydrologic and contaminant distribution data. These sites are composed of offpost sites and onpost sites upgradient and downgradient of the soil-bentonite barrier at the North Boundary.

### 9.2 PROPOSED LOCATIONS

#### Site E-32

**Location:** Proposed well site E-32 is located onpost downgradient from the barrier and is 30 ft west of the east section line (D Street) and 140 ft south of the north section line (96th Avenue) in Section 23, T2S, R67W.

**Rationale:** Proposed well site E-32 will provide hydrologic and water quality data to assess whether first and second Denver sands are acting as contaminant migration pathways beneath the NBCS. Site E-32 is also located directly downgradient of Denver dewatering Well 23342 which is suspected of being poorly completed and may provide a mechanism for cross contamination between aquifers.

Site E-33

**Location:** Proposed well site E-33 is located onpost 175 ft south of the north line (96th Avenue) and 850 ft east of the west line (D Street) in Section 24, T2S, R67W.

**Rationale:** Proposed well site E-33 is located downgradient of the barrier and will provide hydrologic and water quality data in the first and second Denver sands. There are currently no functional Denver wells in this area. This well will be utilized to fill in this data gap and to assess whether these Denver units are acting as contaminant migration pathways.

Site E-34

**Location:** Proposed well site E-34 is located at existing alluvial Well 37338 offpost on the north side of 96th Avenue about 2,500 ft east of the west line (Peoria Street) and 20 ft north of the south line (96th Avenue) in Section 13, T2S, R67W.

**Rationale:** Proposed well site E-34 has been chosen to obtain hydrologic and water quality data in the first and second Denver sands downgradient of the NBCS. There are currently no first or second Denver sands water quality wells in service in this area. Water quality data is needed here to assess if these Denver units are acting as contamination pathways beneath the NBCS.

Site E-39

**Location:** Proposed well site E-39 is located 600 ft north of the south line (96th Avenue) and 2,675 ft east of the west line (Havana Street) in Section 14, T2S, R67W.

**Rationale:** Proposed well site E-39 will provide important geologic data in the assessment of the lateral and northerly extent of the first and second Denver sands. This site is located downgradient of where the first sand is suspected to subcrop and discharge into the alluvium. There are presently no first or second Denver sands wells in this area and monitoring wells in these sand units are required to assess the water quality of the Denver sands downgradient of the barrier at this location.

Site E-40

**Location:** Proposed well E-40 is at the location of existing Well 37305 and is located 1,800 ft west of the east line (Peoria Street) and 1,300 ft north of the south line (96th Avenue) in Section 14, T2S, R67W.

**Rationale:** Proposed well site E-40 will be a cluster site to assess the hydrologic and water quality data in the alluvium and first and second Denver sands downgradient of the NBCS. This alluvial site has been chosen at the location of the projected subcrop and discharge point of a Denver sandstone unit to assess the water quality. The first and second Denver wells will be utilized to assess whether these units are acting as contaminant migration pathways which bypass the NBCS.

Site E-41

**Location:** Proposed well site E-41 is located 1,360 ft west of the east line (Peoria Street) and 1,800 ft north of the south line (96th Avenue) in Section 14, T2S, R67W.

**Rationale:** Proposed well site E-41 will be a cluster site downgradient of the NBCS. This alluvial site has been specifically chosen to assess the water quality downgradient of where a Denver sandstone unit is suspected to subcrop and discharge into the alluvium. In addition, this well will provide hydrologic and water quality data to assess whether the first and second Denver sands are transporting contaminants.

Site E-42

**Location:** Proposed well site E-42 is approximately 380 ft west of the east line (Peoria Street) and 820 ft north of the south line (96th Avenue) of Section 14 T2S, R67W.

**Rationale:** Proposed well site E-42 will provide hydrologic and water quality data in the alluvium and first and second Denver sands downgradient of the NBCS. This site has been chosen upgradient of the suspected subcrop of a Denver sandstone unit and will help define the geology of the area.

Site E-63

**Location:** Proposed well site E-63 is located 1,000 ft east of the west line (Peoria Street) and 900 ft north of the south line (96th Avenue) of Section 13, T2S, R67W.

**Rationale:** Proposed well site E-63 will provide geologic, water quality, and water level data to assess whether the alluvium and first and second Denver sands are contaminated at this site downgradient of the NBCS. Specifically, the alluvial well at this site will assess water quality downgradient of a suspected subcrop and discharge point of a Denver sandstone unit.

Site E-69

**Location:** Proposed well site E-69 is located 230 ft north of the south line (96th Avenue) and 1,260 ft west of the east line (Peoria Street) of Section 14, T2S, R67W.

**Rationale:** Proposed well site E-69 will be a corehole to characterize the geology. The owner at this site did not wish to have permanent wells on his property, but was cooperative in allowing permission to drill a boring and gather geologic information. The site will be specifically utilized to define the first Denver sand just upgradient from where it is suspected to subcrop.

Site EP-19

**Location:** Proposed onpost downgradient well site EP-19 is located 1,780 ft west of the east line (D Street) and 210 ft south of the north line (96th Avenue) in Section 23, T2S, R67W. The site is some 160 ft north of existing Well 23436.

**Rationale:** Proposed well site EP-19 will provide geologic, water quality, and water level data in the alluvium and first and second Denver sands downgradient of the NBCS. An alluvial well has been proposed here to fill in a data gap in the area and also to assess the water quality and the location of a suspected subcrop and discharge point of a Denver sandstone unit. The first and second Denver sandstone wells will provide water

quality and water level data downgradient from wells located in the same sandstone unit, but closer to the soil-bentonite barrier.

Site EP-20

**Location:** Proposed onpost downgradient well site EP-20 is located 1,100 ft west of the east line (D Street) and 140 ft south of the north line (96th Avenue) in Section 23, T2S, R67W.

**Rationale:** Proposed well site EP-20 will provide geologic, water quality, and water level information in the alluvium and first and second Denver sands downgradient of the soil-bentonite barrier. The alluvial well will assess the water quality just downgradient from where a Denver sandstone unit is suspected to subcrop. The first sandstone well is required to assess water quality and water levels downgradient from Well 23202 which is located in the same sandstone unit, but closer to the soil-bentonite barrier. The second sandstone well will help characterize the configuration of the sandstone unit as well as provide water quality and water level data.

Site EP-21

**Location:** Proposed onpost downgradient well site EP-21 is located 650 ft west of the east line (D Street) and 130 ft south of the north line (96th Avenue) in Section 23, T2S, R67W.

**Rationale:** Proposed well site EP-21 will provide geologic, water quality, and water level data in the alluvium and first and second Denver sands downgradient of the NBCS. The alluvial well will provide data to assess the water quality just downgradient of where a Denver sandstone unit is suspected to subcrop into the alluvium. The first sandstone well is required to assess water quality and water levels downgradient from wells located in the same sandstone unit that are closer to the soil-bentonite barrier. From work done by ESE, this sand unit appears to be a major channel sand that goes under the soil-bentonite barrier. A second Denver sand well at this site will characterize the configuration of the sand unit and also provide water quality and water level data.



Site EP-22

**Location:** Proposed onpost downgradient well site EP-22 is located 1,950 ft west of the east line (D Street) and 220 ft south of the north line (96th Avenue) in Section 24, T2S, R67W.

**Rationale:** Proposed well site EP-22 will provide geologic, water quality, and water level data in the alluvium and first and second Denver sands. Currently, there are no Denver wells downgradient of the soil-bentonite barrier at this location.

Site EP-25

**Location:** Proposed onpost downgradient well site EP-25 is located 850 ft west of the east line (D Street) and 900 ft south of the north line (96th Avenue) in Section 23, T2S, R67W.

**Rationale:** Proposed well site EP-25 will provide geologic, water quality, and water level data in the first Denver sand upgradient of the NBCS. This site has been chosen to better define the eastern lateral extent of the channel sand which is mentioned under site EP-21. This well will help to determine points of entry for contaminants into this unit.

Site EP-26

**Location:** Proposed onpost downgradient well site EP-26 is located 210 ft west of the east line (D Street) and 1,700 ft south of the north line (96th Avenue) in Section 23, T2S, R67W.

**Rationale:** Proposed well site EP-26 will provide geologic, water quality, and water level data in the first Denver sand upgradient of the NBCS. This site was chosen to better define the western lateral extent of the channel sand which appears to continue under the soil-bentonite barrier and points of entry for contaminants into this unit.

Site EP-27

**Location:** Proposed onpost downgradient well site EP-27 is located 710 ft west of the east line (D Street) and 1,130 ft south of the north line (96th Avenue) in Section 23, T2S, R67W.

**Rationale:** Proposed well site EP-27 will provide geologic, water quality, and water level data in a major first Denver sandstone unit upgradient of the NBCS. This proposed well has been placed directly in the center of the suspected channel sand and will assist in determining points of entry for contamination into this unit.

Site EP-28

**Location:** Proposed onpost downgradient well site EP-28 is located 2,480 ft west of the east line (D Street) and 235 ft south of the north line (96th Avenue) in Section 23, T2S, R67W.

**Rationale:** Proposed well site EP-28 will provide geologic, water quality, and water level data in the alluvium and first Denver sand. The alluvial well will be utilized to assess the water quality just downgradient of a suspected subcrop of a Denver sand unit. The first Denver sand well will help characterize the water quality and the extent of the first sandstone in this downgradient area.

Site EP-76

**Location:** Proposed well site EP-76 is located approximately 200 ft south of the north section line and 505 ft west of the east section line of Section 23 (T2S, R67W).

**Rationale:** Provide geologic data for stratigraphic correlations.

## 10.0 TASK 38

### 10.1 OBJECTIVES

The objectives of Task 38 are as follows:

- o Determine the source(s) of TCE in ground water in the Western Tier;
- o For such source(s), define the contaminant plume between the source and the RMA boundary; and
- o Obtain all other data necessary for the Army, in consultation with U.S. Environmental Protection Agency (EPA), Colorado, and Shell, to determine appropriate removal or final remedial action to be taken with respect to the TCE source and/or the TCE plume of contamination.

These objectives are accomplished through the conduct of a remedial investigation and preliminary remedial alternatives assessment. The remedial investigation includes a detailed review of historical records, personal interviews, geophysics studies, soil gas studies, soil borings and analysis, well installation, ground-water sampling and analysis, and building (sumps, drains, etc.) sampling and analysis.

Ground-water monitoring wells will be installed and sampled to assess the degree and extent of ground-water contamination in the Western Tier. It is the intent of this study to verify the presence of contaminant sources and to determine whether migration of contaminants has occurred which may be contributing to low levels of contaminants measured in nearby SACWSD water supply wells.

Studies of the DBCP plume in Section 33 indicate that contaminant plumes will be narrow in the Western Tier. Wells must be placed in the centerline of the plume in order to accurately track contaminant movement. The present monitoring well network does not appear to adequately define TCE migration in the Western Tier area. Data from the new wells together with information collected from the present monitoring well network will help to further define the local ground-water flow system and the limits of contamination.

A total of 22 ground-water monitoring wells or well clusters are expected to be installed and sampled to assess the degree and extent of ground-water contamination in the Western Tier. Note that locations are tentative. Exact locations will be determined based upon information obtained during the study.

These wells will provide data for the evaluation of ground water at the sites. Wells are also planned for the far western border of RMA where ground-water data are sparse. Analyses of samples from these wells are expected to define whether contaminants are migrating from the eastern side of Section 4 to the far western borders of Sections 4 and 33. Four wells/well clusters are planned for sites in Section 9. At least one well will be installed in the middle of a bedrock valley in the northwestern corner of Section 33, a valley which is to be mapped by geophysical methods. The SACWSD wells are located in this bedrock valley. Other wells will be located following further analysis of geophysical and hydrological data.

## 10.2 PROPOSED LOCATIONS

### Site WT33-1

**Location:** Proposed well site WT33-1 is in the northwest quarter of Section 33, approximately 900 ft east of the west section line and 2,700 ft north of the south section line (December Seventh Avenue). One alluvial well is proposed for this site.

**Rationale:** Proposed well site WT33-1 was located to provide water quality data between a mapped TCE soil gas plume in the center of Section 33 and the contaminated SACWSD well on the northwest side of Section 33.

### Site WT33-2

**Location:** Proposed well site WT33-2 is in the northwest quarter of Section 33, approximately 1,200 ft east of the west section line and 2,950 ft north of the south section line (December Seventh Avenue). Three nested alluvial wells are proposed for this site each screening a maximum of 20 ft of the aquifer.

**Rationale:** Proposed well site WT33-2 will provide geologic, water quality, and water level data for alluvium filling a bedrock channel known to be in this area.

Site WT33-3

**Location:** Proposed well site WT33-3 is in the southwest quarter of Section 33, approximately 2,050 ft east of the west section line and 1,050 ft north of the south section line (December Seventh Avenue). Two nested alluvial wells are proposed for this site each screening a maximum of 20 ft of the aquifer.

**Rationale:** Proposed well site WT33-3 was located to intercept a TCE groundwater plume mapped by the Tracer soil gas methodology, emanating from Sites 4-2 and 4-6 to the south.

Site WT4-1

**Location:** Proposed well site WT4-1 is in the northwest quarter of Section 4, approximately 2,000 ft east of the west section line and 50 ft south of the north section line (December Seventh Avenue). Two nested alluvial wells are proposed for this site each screening a maximum of 20 ft of the aquifer.

**Rationale:** Proposed well site WT4-1 was located to intercept a TCE groundwater plume mapped by the Tracer soil gas methodology, emanating from Site 4-2 to the south.

Site WT4-2

**Location:** Proposed well site WT4-2 is in the northeast quarter of Section 4, approximately 1,300 ft west of the east section line (B Street) and 1,000 ft south of the north section line (December Seventh Avenue), in Site 4-4. One alluvial well is proposed for this site that will screen 20 ft of the upper aquifer.

**Rationale:** Proposed well site WT4-2 was located to intercept a TCE groundwater plume mapped by the Tracer soil gas methodology, emanating from Site 4-6 to the south.

Site WT4-3

**Location:** Proposed well site WT4-3 is in the northwest quarter of Section 4, approximately 850 ft east of the west section line and 2,250 ft south of the north section line (December Seventh Avenue). Three nested alluvial wells are proposed for this site each screening a maximum of 20 ft of the aquifer.

**Rationale:** Proposed well site WT4-3 was located to provide geologic data on a suspected bedrock channel located on the east side of Section 4 and to provide water quality and water level data from this area.

Site WT4-4

**Location:** Proposed well site WT4-4 is in the western half of Section 4, approximately 2,200 ft east of the west section line and 2,600 ft south of the north section line (December Seventh Avenue). One alluvial well is proposed for this site which will screen the entire alluvial aquifer thickness estimated at 20 ft.

**Rationale:** Proposed well site WT4-4 was located to intercept a TCE groundwater plume mapped by the Tracer soil gas methodology, emanating from Site 4-2 to the south.

Site WT4-5

**Location:** Proposed well site WT4-5 is in the southwest quarter of Section 4, approximately 1,000 ft east of the west section line and 1,750 ft north of the south section line (Sixth Avenue). One alluvial well is proposed for this site which will screen the entire alluvial aquifer thickness estimated at 20 ft.

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**Rationale:** Proposed well site WT4-5 was located to provide geologic data on a suspected bedrock channel located on the east side of Section 4 and to provide water quality and water level data from this area.

Sites WT4-6, WT4-7, WT4-8, WT4-9, WT4-10, and WT4-11

**Location:** These proposed well sites are located in Site 4-6 in the southeast corner of Section 4. Each will be completed to a maximum depth of 20 ft in the alluvial aquifer.

**Rationale:** These proposed well sites were located to delineate the source of TCE contamination in the ground-water as mapped by the Tracer soil gas study emanating from Site 4-6.

Site WT4-12

**Location:** The proposed well site WT4-12 is located in Site 4-2 in the southern half of section 4, approximately 2,800 ft east of the west section line and 850 ft north of the south section line (Sixth Avenue). One well will be completed to a maximum depth of 20 ft in the alluvial aquifer.

**Rationale:** The proposed well site WT4-12 was located to delineate the source of TCE contamination in the ground-water as mapped by the Tracer soil gas study to be emanating from Site 4-2.

Site WT4-13

**Location:** Proposed well site WT4-13 is in the southwest quarter of Section 4, approximately 1,200 ft east of the west section line and 450 ft north of the south section line (Sixth Avenue). One well will be completed to a maximum depth of 20 ft in the alluvial aquifer.

**Rationale:** Proposed well site WT4-13 was located to provide geologic data on a suspected bedrock channel located on the east side of Section 4 and to provide water quality and water level data from this area.

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Site WT3-1

**Location:** Proposed well site WT3-1 is in the southeast quarter of Section 3, approximately 450 ft east of the west section line and 50 ft north of the south section line (Sixth Avenue). One alluvial well is proposed for this site which will screen a maximum of 20 ft of the aquifer.

**Rationale:** Proposed well site WT3-1 was located to monitor ground-water quality upgradient of Site 4-6 and to provide water level information.

Site WT9-1

**Location:** Proposed well site WT9-1 is in the northeast quarter of Section 9, approximately 1,100 ft west of the east section line and 100 ft south of the north section line (Sixth Avenue). One alluvial well is proposed for this site which will screen the entire alluvial aquifer thickness estimated at 20 ft.

**Rationale:** Proposed well site WT9-1 was located based on a TCE "hot spot" identified by the Petrex soil gas study.

Site WT9-2

**Location:** Proposed well site WT9-2 is in the northeast quarter of Section 9, approximately 2,050 ft west of the east section line and 1,650 ft south of the north section line (Sixth Avenue). Two nested alluvial wells are proposed for this site, each screening a maximum of 20 ft of the alluvial aquifer.

**Rationale:** Proposed well site WT9-2 was located based on a TCE "hot spot" identified by the Petrex soil gas study.

Site WT9-3

**Location:** Proposed well site WT9-3 is in the northeast quarter of Section 9, approximately 10 ft west of the east section line and 2,550 ft south of the north section line (Sixth Avenue). One alluvial well is proposed for this site to screen 20 ft of the aquifer.



**Rationale:** Proposed well site WT9-3 was located to provide alluvial water level and bedrock data in an area identified as a data gap.

Site WT9-4

**Location:** Proposed well site WT9-4 is in the southeast quarter of Section 9, approximately 1,750 ft west of the east section line and 1,250 ft north of the south section line. Two nested alluvial wells are proposed for this site, each screening a maximum of 20 ft of the alluvial aquifer.

**Rationale:** Proposed well site WT9-4 was located based on a TCE "hot spot" identified by the Petrex soil gas study.

Site WT9-5

**Location:** Proposed well site WT9-5 is in the southeast quarter of Section 9, approximately 1,650 ft west of the east section line and 100 ft north of the south section line. Two nested alluvial wells are proposed for this site, each screening a maximum of 20 ft of the alluvial aquifer.

**Rationale:** Proposed well site WT9-5 was located to identify any contaminated ground-water entering RMA from the south.

## 11.0 TASK 39

### 11.1 OBJECTIVES

There are two primary objectives of the proposed monitoring program. The first and most important objective of this task is to delineate suspected contaminated alluvial ground-water plumes that may be emanating from the RMA northern boundary. This will include further definition of the known contaminant plume extending northwestward from the northern boundary along the inferred First Creek paleochannel described in the Offpost Contamination Assessment Report (CAR) (ESE, 1987, RIC#87202R01). It will also include determining whether contaminant plumes extend from the RMA northern boundary to remote areas to the north of RMA where isolated detections of several organic contaminants have been documented. Any plumes that are defined in this area will be specifically delineated in enough detail to evaluate remedial action alternatives if the need for remedial actions is established.

A second objective of the offpost proposed monitoring plan is to assess the quality of ground water in Denver Fm aquifers downgradient of the RMA northern boundary. Of particular concern is whether these units are acting as contaminant migration pathways which bypass the NBCS. The data from these wells will also be used to assess to what extent, if any, ground water from the Denver Fm may be contributing to alluvial aquifer contamination. This scenario is being addressed in this study because many of the Denver Fm units subcrop and discharge into the alluvium immediately downgradient of the RMA northern boundary. However, most of the Denver Fm wells will be addressed under Task 36.

Based upon the results of geologic, hydrologic, and chemical analyses from these wells and boreholes, additional sites may be developed. These sites will be installed to provide specific data identified as being needed based on the initial group of sites. Specific locations are described in the following sections.

## 11.2 PROPOSED LOCATIONS

### Site E-36

**Location:** Proposed Site E-36 is along the west side of Potomac Street approximately 20 ft west of the east line and 500 ft north of the south line in the southeast quarter, southeast quarter of Section 13. This site is for a possible cluster of one alluvial and two Denver wells.

**Rationale:** Proposed well site E-36 was located to provide geologic, water quality, and water level data northeast of the NBCS.

### Site E-38

**Location:** Proposed site E-38 is a site for the installation of a possible cluster of one alluvial and two Denver wells along the west side of Highway 2, approximately 1,200 ft northeast of the intersection of East 96th Avenue. The site is 900 ft east of the west section line and 900 ft north of the south section line lying in the southwest quarter, southwest quarter of Section 14.

**Rationale:** Proposed well site E-38 is located to assess the configuration, extent, and water quality of Denver sand units northwest of the NBCS. This well cluster will fill a large data gap that exists in this area.

### Site E-43

Proposed well site E-43 is located in 1,500 ft north of the south line and 2,650 ft east of the west line of Section 13.

**Rationale:** Proposed alluvial well site E-43 will provide water quality and geologic data to assess whether a well-defined alluvial channel exists in this area of Section 13, and if such a channel is acting as a primary pathway for contaminant migration to areas further north.

### Site E-44

**Location:** Proposed well site E-44 is located approximately 1,600 ft west of the east line and 2,000 ft north of the south line of Section 14.

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**Rationale:** Proposed well site E-44 has been located to define the documented contaminant plume that appears to be associated with the inferred First Creek paleochannel. In addition, first and second Denver sand wells will provide geologic, water quality, and water level data, to assess whether these units are contaminated at this site downgradient of the NBCS.

Site E-45

**Location:** Proposed well Site E-45 is along the east side of Peoria Street about 20 ft east of the west line and 2,050 ft north of the south line of Section 13 lying in the northwest quarter, southwest quarter of Section 13. This site is for a cluster of two Denver wells at the site of the existing alluvial Well 37323.

**Rationale:** Proposed well site E-45 will provide geologic, water quality, and water level data in the first and second Denver sands downgradient of the NBCS. There are currently no functional Denver wells in this area.

Site E-46

**Location:** Proposed well site E-46 is 2,600 ft north of the south line and 1,300 ft east of the west line of Section 13. There will be one alluvial and two Denver wells installed at the well site.

**Rationale:** Proposed well site E-46 will provide geologic, water quality, and water level data in the alluvium and first and second Denver sands downgradient of the NBCS. The alluvial well at this site will assess whether a well-defined alluvial channel exists in this area and if such a channel is acting as a primary pathway for contaminant migration to areas further north. The Denver wells will be utilized to assess the configuration, extent, and water quality of the first and second Denver sand units downgradient of the NBCS.

Site E-47

**Location:** Proposed well site E-47 is located 2,600 ft north of the south line and 2,550 east of the west line of Section 13.

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**Rationale:** Proposed well site E-47 will provide geologic, water quality, and water level data in the alluvium and first and second Denver sands. The alluvial well at this site will be specifically utilized to assess whether a well-defined alluvial channel exists in this area and if such a channel is acting as a primary pathway for contaminant migration to areas further north. The Denver wells will provide data to assess the configuration, extent, and water quality of the first and second Denver sand units downgradient of the NBCS.

Site E-48

**Location:** Proposed well site E-48 is located 2,600 ft north of the south line and 1,300 west of the east line of Section 13.

**Rationale:** Proposed well site E-48 will provide geologic, water quality, and water level data in the alluvium downgradient of the NBCS. The purpose of this alluvial well is to assess whether a well-defined alluvial channel exists in this area and if such a channel is acting as a primary pathway for contaminant migration to areas further north.

Site E-49

**Location:** Proposed well site E-49 lies along the east side of Potomac Street about 2,750 ft north of the south line and 20 ft east of the west line in the northwest quarter, southeast quarter of Section 18. This site is for the installation of two Denver wells at the site of existing alluvial Well 37327.

**Rationale:** Proposed well site E-49 will provide geologic, water quality, and water level data in the first and second Denver sands to the northeast of the NBCS. These wells are required to assess the configuration, extent, and water quality of the first and second Denver sands at this location.

Site E-50

**Location:** Proposed well site E-50 is a site for the installation of one alluvial well and one optional Denver well along the west side of Highway 2. It is 3,100 ft east of the west line and 3,500 ft north of the south line of

Section 14 and lies in the southwest quarter, northeast quarter of Section 14.

**Rationale:** Proposed well site E-50 is required to define the documented contaminant plume that appears to be associated with the inferred First Creek paleochannel. In addition, a first Denver sand well will provide geologic, water quality, and water level data to assess whether this unit is contaminated at this location.

Site E-51

**Location:** Proposed well site E-51 is at the site of an existing shallow Well 37342 where an additional one or two optional Denver wells will be installed. The site is approximately 3,800 ft east of the west line and 4,200 ft north of the south line of Section 14 in the northwest quarter, northeast quarter of Section 14.

**Rationale:** Proposed well site E-51 will provide geologic, water quality, and water level data in the first and second Denver sands downgradient of the NBCS. These wells are required to assess the configuration, extent, and water quality of these sand units at this location.

Site E-52

**Location:** Proposed well site E-52 is along the northwest side of Peoria Street approximately 500 ft northeast of the intersection with East 104th Avenue. This site is in the southeast quarter, southeast quarter of Section 11, approximately 400 ft west of the east line and 400 ft north of the south line of Section 11. This site will be used for the installation of one alluvial well.

**Rationale:** Proposed well site E-52 will be utilized to assess the extent of alluvial ground water contamination in the vicinity of Well 37344 and the Boller Well. This zone represents an area more than a mile downgradient of the NBCS where substantial concentrations of organic contaminants have been detected.

Site E-53

**Location:** Proposed well site E-53 is along the north side of East 104th Avenue, approximately 900 ft east of the west line and 20 ft north of the south line in the southwest quarter, southwest quarter of Section 12. This site is for the installation of one alluvial well and two optional Denver wells.

**Rationale:** Proposed well site E-53 will provide geologic, water quality, and water level data in the alluvium and first and second Denver sands downgradient of the NBCS. The alluvial well will be specifically utilized to identify the extent of alluvial ground-water contamination in the vicinity of Well 37344 and the Boller Well. This zone represents an area more than a mile downgradient of the NBCS where substantial organic contaminants have been detected. The Denver wells are required to assess the configuration, extent, and water quality of the first and second Denver sands at this location.

Site E-54

Proposed well site E-54 is along the north side of East 104th Avenue, approximately 3,300 ft east of the west line and 20 ft north of the south line the southwest quarter, southeast quarter of Section 12. This site is for the installation of one alluvial well and two optional Denver wells.

**Rationale:** Proposed well site E-54 will provide geologic, water quality, and water level data in the alluvium and first and second Denver sands downgradient of the NBCS. The alluvial well will be specifically utilized to identify the extent of alluvial ground-water contamination in the vicinity of Well 37344 and the Boller Well. This zone represents an area more than a mile downgradient of the NBCS where substantial organic contaminants have been detected. The Denver wells are required to assess the configuration, extent, and water quality of the first and second Denver sands at this location.

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Site E-57

**Location:** Proposed well site E-57 is along the north side of Highway 44 (East 104th Avenue west of the junction with Highway 2) which runs along the south line of Section 11. The site is about 3,500 ft east of the west line and 30 ft north of the south line lying in the southwest quarter, southeast quarter of Section 11. This site is for the installation of one optional alluvial well.

**Rationale:** Proposed well site E-57 will provide geologic, water quality, and water level data in the alluvium substantially downgradient of the NBCS. This well is required to assess the extent of alluvial contamination substantially downgradient of the NBCS and away from known areas of high contamination.

Site E-58

**Location:** Proposed well site E-58 is along the west side of Peoria Street, about 1,700 ft north of the south line and 20 ft west of the east line in the northeast quarter, southeast quarter of Section 11. This site is for the installation of one alluvial well.

**Rationale:** The proposed well site E-58 will be utilized to assess the extent of alluvial ground-water contamination in the vicinity of the "Boller Well" and Well 37344. This zone represents an area more than a mile downgradient of the NBCS where substantial concentrations of organic contaminants have been detected.

Site E-59

**Location:** Proposed well site E-59 lies along the northwest side Highway 2, approximately 1,900 ft east of the west line and 2,800 ft north of the south line in the southeast quarter, northwest quarter of Section 12. This installation is for one optional alluvial well.

**Rationale:** Proposed well site E-59 will provide geologic, water quality, and water level data in the alluvium downgradient of the NWBCS. This well



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is required to assess the extent of alluvial contamination downgradient of the NBCS and away from known areas of high contamination.

Site E-60

The proposed well site E-60 is 50 ft east of the west line and 2,600 ft north of the south line in the northwest corner of the southwest corner of Section 15.

**Rationale:** Proposed well site E-60 will provide geologic, water quality, and water level data in the alluvium downgradient of the NWBCS. This well is required to assess the extent of alluvial contamination downgradient of the NWBCS and away from known areas of high contamination.

Site E-61

**Location:** Proposed well site E-61 is along the north side of Highway 44, approximately 100 ft east of the west line and 30 ft north of the south line in the southwest quarter, southwest quarter of Section 11. This site is for the installation of one optional alluvial well.

**Rationale:** Proposed well site E-61 will provide geologic, water quality, and water level data in the alluvium substantially downgradient of the NBCS. This well is required to assess the extent of alluvial contamination substantially downgradient of the NBCS and away from known areas of high contamination.

Site E-62

**Location:** Proposed well site E-62 is located in the center of Section 11, approximately 2,600 ft south of the north line and 2,600 ft east of the west line of Section 11.

**Rationale:** Proposed well site E-62 will provide geologic, water quality, and water level data in the alluvium substantially downgradient of the NBCS. This well is required to assess the extent of alluvial contamination substantially downgradient of the NBCS and away from known areas of high contamination.

Site E-64

**Location:** Proposed well site E-64 is along the east side of Peoria Street, approximately 4,000 ft north of the south line and 20 ft east of the west line of Section 13.

**Rationale:** Proposed well site E-64 will provide geologic, water quality, and water level data in the alluvium and first and second Denver sands downgradient of the NBCS. The alluvial well at this site will assess whether a well-defined alluvial channel exists in this area and if such a channel is acting as a primary pathway for contaminant migration to areas further north. The Denver wells will be utilized to assess the configuration, extent, and water quality of the first and second Denver sand units downgradient of the NBCS.

Site E-65

**Location:** Proposed well site E-65 is located approximately 1,000 ft east of Highway 2. The site is 2,800 ft west of Peoria Street (the line dividing Section 13 and 14) and 1,700 ft north of 96th Avenue (the RMA north boundary) on private land.

**Rationale:** Proposed well site E-65 will provide geologic water quality and water level data in the alluvium and first and second Denver sands downgradient of the NBCS. This cluster site will fill a large data gap and aid in the assessment of offpost contaminant migration.

Site E-70

**Location:** Proposed well site E-70 is just off of Peoria Street, 550 ft north of 96th Avenue.

**Rationale:** Proposed well site E-70 is a replacement for Well 37308 which has no construction documentation. This alluvial well is needed to fill in a data gap in water levels and water quality.

Site E-71

**Location:** Proposed well site E-71 is located 50 ft east of Peoria Street and 1,300 ft north of 96th Avenue.

**Rationale:** Proposed well site E-71 is a replacement for Well 37309 which has no construction documentation. This alluvial well is needed to fill in a data gap in water levels and water quality.

Site E-72

**Location:** Proposed well site E-72 is located 2,400 ft north of 96th Avenue and just east of Highway 2.

**Rationale:** Proposed well site E-72 is a replacement for Well 37313. This alluvial well is needed to fill in a data gap in water levels and water quality.

Site E-73

**Location:** Proposed well site E-73 is located 690 ft east of Peoria Street and approximately 2,600 ft north of 96th Avenue on private land.

**Rationale:** Proposed well site E-73 will provide geologic, water quality, and water level data in the alluvium and first and second Denver sands downgradient of the NBCS. The alluvial well at this site will assess whether a well-defined alluvial channel exists in this area and if such a channel is acting as a primary pathway for contaminant migration to areas further north. The Denver wells will be utilized to assess the configuration, extent, and water quality of the first and second Denver sand units downgradient of the NBCS.

Site E-74

**Location:** Proposed well site E-74 is located 1,900 ft east of Peoria Street and approximately 2,600 ft north of 96th Avenue.

**Rationale:** Proposed well site E-74 will provide geologic water quality and water level data in the alluvium and first and second Denver sands

downgradient of the NBCS. The alluvial well at this site will assess whether a well-defined alluvial channel exists in this area and if such a channel is acting as a primary pathway for contaminant migration to areas further north. The Denver wells will be utilized to assess the configuration, extent, and water quality of the first and second Denver sand units downgradient of the NBCS.

Site E-75

**Location:** Proposed well site E-75 is located along East 104th Avenue, 300 ft east of Peoria Street.

**Rationale:** Proposed well site E-75 will be utilized to assess the extent of alluvial ground water contamination in the vicinity of Well 37344 and the "Boller Well". This zone represents an area more than a mile downgradient of the NBCS where substantial concentrations of organic contaminants have been detected.

Site E-76

**Location:** Proposed well site E-76 is located along East 104th Avenue, 1,450 ft east of Peoria Street.

**Rationale:** Proposed well site E-75 will be utilized to assess the extent of alluvial ground-water contamination in the vicinity of Well 37344 and the "Boller Well". This zone represents an area more than a mile downgradient of the NBCS where substantial concentrations of organic contaminants have been detected.

## 12.0 TASK 42

### 12.1 OBJECTIVES

The objectives of Task 42 are as follows:

- o Assess whether potential contamination exists in the soil or ground water of the North Plants area and to identify the analytes present;
- o To conduct a preliminary evaluation of the vertical and horizontal extent of contamination present in the North Plants; and
- o To provide site-specific information upon which to base the upcoming feasibility studies for eventual remediation.

These objectives are accomplished through chemical analyses of 213 Phase I and 166 Phase II soil samples, and ground water samples collected from the six alluvial wells installed during an extended Phase I survey.

The alluvial ground-water monitoring wells will be installed and sampled within the main manufacturing/demilitarization area to:

- o Provide an estimate of the vertical and areal extent of potential contamination within the alluvial aquifer;
- o Determine the alluvial aquifer thickness and direction of ground-water flow;
- o Delineate if Denver sand aquifers are in direct contact with saturated alluvium at each well site;
- o Estimate if potential ground-water contaminants may have originated from North Plants operations;
- o Provide information to the RI/FS database for designing remedial measures, if necessary; and
- o Provide information that will assist in performing remedial functions.

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## 12.2 PROPOSED LOCATIONS

### Site 25041

**Location:** Proposed well site 25041 is in the southeast quarter of Section 25, approximately 1,500 ft west of the east section line and 1,300 ft north of the south section line. One alluvial well is planned for this site.

**Rationale:** Proposed well site 25041 is located to provide upgradient water quality data.

### Site 25042

**Location:** Proposed well site 25042 is in the southeast quarter of Section 25, approximately 2,050 ft west of the east section line and 1,750 ft north of the south section line. One alluvial well is planned for this site.

**Rationale:** Proposed well site 25042 is located in the Tank Farm 1403 area downgradient from Phase I soil Borings 36 and 45 where benzene was detected.

### Site 25043

**Location:** Proposed well site 25043 is in the southeast quarter of Section 25, approximately 1,500 ft west of the east section line and 1,960 ft north of the south section line. One alluvial well is planned for this site.

**Rationale:** Proposed well site 25043 is located within a fuel oil spill site area downgradient of Task 42 Phase I soil boring 42 where benzene and DMMP were detected.

### Site 25044

**Location:** Proposed well site 25044 is in the southeast quarter of Section 25 approximately 1,800 ft west of the east section line and 1,960 ft north of the south section line. One alluvial well is planned for this site.

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**Rationale:** Proposed well site 25044 is located within a fuel oil spill site area downgradient of Task 42 Phase I soil Boring 40 and the chemical sump where DMMP was detected.

Site 25046

**Location:** Proposed well site 25046 is in the northeast quarter of Section 25 approximately 1,800 ft west of the east section line and 2,000 ft south of the north section line. One alluvial well is proposed at this site.

**Rationale:** Proposed well site 25046 is located downgradient of Building 1611 and Phase I soil Borings 27 and 50 where DMMP and chromium, respectively, were detected.

Site 25047

**Location:** Proposed well site 25047 is in the southeast quarter of Section 25 approximately 2,200 ft west of the east section line and 2,250 ft north of the south section line. One alluvial well is proposed at this site.

**Rationale:** Proposed well site 25047 is located downgradient of the main manufacturing and scrubber areas to determine if ground water may have been contaminated by operations in these areas.

### 13.0 TASK 44

#### 13.1 OBJECTIVES

Task 44 is the long-term monitoring network designed to implement regional ground-water monitoring in both the onpost and offpost areas. The task will serve as the baseline or "trunk" program for all hydrologic investigations performed at RMA. Various other ground-water efforts are planned or are underway at RMA. These tasks deal with site specific investigations such as the boundary systems, primary potential sites, and/or potential migration pathways. Additionally, the various soil investigations contain certain ground-water components. These other ground-water activities are regarded as branch efforts which will augment the regional program with a more detailed level of understanding for the site-specific area in which the respective programs operate.

Functioning as the core hydrologic program, Task 44 is designed to satisfy the following objectives:

- o Assess the distribution and concentration levels of ground-water contaminants and monitor changes in water quality for both onpost and offpost areas;
- o Monitor and evaluate changes in water levels;
- o Evaluate and make recommended program modifications to this and other ground-water tasks; and
- o Identify areas of significant public health exposure.
- o Integrate all ground-water related efforts.

The satisfaction of these goals will provide personnel working with the RMA EA and FS groups with a characterization of contaminant hydrogeology and, as related to this document, provide a mechanism for identifying and filling data deficiencies between various hydrologic efforts conducted at RMA.



### 13.2 PROPOSED LOCATIONS

#### Site EP-53

**Location:** Proposed well site EP-53 is located 250 ft north of the south section line and 1,000 ft west of the east section line of Section 23, T2S, R67W.

**Rationale:** Proposed well sites EP-53 will provide hydrologic and water quality data downgradient of Basin F for both alluvial and Denver sand aquifers. Subsurface evaluations indicate that the proposed site will monitor ground-water flow and water quality in a major alluvial contaminant pathway originating from Basin F and consequently aid in a more detailed assessment of contaminant characterization and transport. Additionally, the Denver sand wells will provide chemical and stratigraphic information which will augment the Denver Fm investigation conducted under Task 36 by contributing upgradient water quality, geologic, and hydrologic data. Also, there are currently no well clusters in the area. Installation of the proposed well site will fill a gap in the areal distribution of regional cluster sites.

#### Site EP-54

**Location:** Proposed well site EP-54 is located 250 ft south of the north section line and 2,100 ft west of the east section line of Section 26, T2S, R67W.

**Rationale:** Proposed well site EP-54 will provide hydrologic and water quality data downgradient of Basin F in the alluvial aquifer. An evaluation of contaminant distribution and subsurface structures reveal that the site will monitor alluvial ground-water flow and water quality in a major contaminant pathway originating from Basin F and consequently aid in a more detailed assessment of contaminant characterization and transport. The proposed site will provide a monitoring point at a location where existing wells in the area are of undocumented construction.

Site EP-55

**Location:** Proposed well site EP-55 is located 50 ft south of the north section line and 2,450 ft west of the east section line of Section 26, T2S, R67E.

**Rationale:** Proposed well site EP-55 will provide hydrologic and water quality data downgradient of Basin F in the alluvial aquifer. An evaluation of contaminant distribution and subsurface structure reveal that the site will monitor alluvial ground-water flow and water quality in the area, and consequently aid in contaminant characterization and plume definition. Additionally, stratigraphic information obtained during drilling will augment the bedrock interpretation in the area. The proposed site will provide a monitoring point at a location where existing wells in the area are of undocumented construction.

Site EP-56

**Location:** Proposed well site EP-56 is located 100 ft south of the north section line and 2,000 ft east of the west section line of Section 26, T2S, R67W.

**Rationale:** Proposed well site EP-56 will provide hydrologic and water quality data downgradient of Basin F for both alluvial and Denver sand aquifers. Subsurface evaluations indicate that the proposed site will monitor ground-water flow and water quality in a possible alluvial contaminant pathway originating from Basin F and consequently aid in a more detailed assessment of contaminant characterization and plume definition. Additionally, the Denver sands wells will provide chemical and stratigraphic information which will augment the Denver Fm investigation conducted under Task 36 by contributing upgradient water quality, geologic, and hydrologic data. Also, there are currently no well clusters in the area. Installation of the proposed well site will fill a gap in the areal distribution of regional cluster sites.

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Site EP-62

**Location:** Proposed well site EP-62 will be located in Section 34, T2S, R67W. Location will be finalized following an evaluation of new Shell well installation and sampling data.

**Rationale:** As a result of the data review it is believed that EP-62 should be installed in a cluster configuration to provide data which will aid in the evaluation of geology, hydrogeology, and contaminant distribution in the Denver Fm.

Site EP-64

**Location:** Proposed well site EP-64 is located 2,400 ft north of the south section line and 700 ft east of the west section line of Section 34, T2S, R67W.

**Rationale:** Proposed well site EP-64 will provide hydrologic and water quality data along a potential alluvial migration pathway originating from the rail classification yard or the lower lakes. An evaluation of the subsurface geology indicates that the site will monitor ground-water flow and water quality in an area of a possible confluence of two paleochannels and consequently provide the data to determine if this is the case. Additionally, the proposed well site fills a gap in the areal distribution of alluvial wells in the regional network and will aid in plume definition and water table interpretation.

Site EP-65

**Location:** Proposed well site EP-65 is located 2,200 ft north of the south section line and 550 ft west of the east section line of Section 34, T2S, R67W.

**Rationale:** Proposed well site EP-65 will provide hydrologic and water quality data for both alluvial and Denver sands aquifers. Subsurface evaluations indicate that the proposed site will monitor ground-water flow and water quality in a paleochannel originating from the South Plants and consequently augment plume definition and flow direction. Additionally, the site will provide geologic information which will refine current bedrock and

Denver sands interpretation. Installation of the site will fill a gap in the areal distribution of regional cluster sites and provide a distal monitoring point for Denver sands monitoring.

Site EP-66

**Location:** Proposed well site EP-66 is located 1,100 ft south of the north section line and 1,250 ft west of the east section line of Section 3, T2S, R67W.

**Rationale:** Proposed well site EP-66 will provide hydrologic and water quality data for the alluvial and Denver sand aquifers in an area of sparse information west of the South Plants. Subsurface evaluations indicate the presence of a paleochannel in the area of the lower lakes with which contamination seems to coincide. Installation of this well site will better define contaminant extent and character, as well as add to the interpretation of Denver sands geology.

Site EP-67

**Location:** Proposed well site EP-67 will be located in Section 35, T2S, R66W. Location will be finalized following evaluation of new Shell and EBASCO well installations.

**Rationale:** Evaluated of Shell and EBASCO activities in the area of the proposed site resulted in the decision to install a cluster combination to augment other cluster configurations in the area and thereby provide additional geologic and hydrogeologic data regarding the Denver Fm.

Site EP-71

**Location:** Proposed well site EP-71 is located 1,400 ft south of the north section line and 1,050 ft west of the east section line of Section 22, T2S, R67W.

**Rationale:** Proposed well site EP-71 will provide geologic, hydrologic, and water quality data for both alluvial and Denver sands aquifers. The proposed site fills a gap in the areal distribution of monitoring well locations.

Site EP-72

**Location:** Proposed well site EP-72 is located 1,300 ft south of the north section line and 1,800 ft east of the west section line of Section 23, T2S, R67W.

**Rationale:** Proposed well site EP-72 will provide geologic, hydrologic, and water quality data for both alluvial and Denver sands aquifers. The proposed site fills a gap in the areal distribution of monitoring well locations.

Site EP-74

**Location:** Proposed well site EP-74 is located 1,600 ft north of the south section line and 1,400 ft west of the east section line of Section 24, T2S, R67W.

**Rationale:** Proposed well site EP-74 will provide geologic, hydrologic, and water quality data for alluvial and Denver sands aquifers. The proposed location will monitor alluvial ground-water flow and water quality along the major contamination plume upgradient of the NBCS and will refine plume definition and contaminant characterization. Additionally, the Denver sand wells will provide chemical and stratigraphic information which will augment the Denver Fm investigation conducted under Task 36 by contributing upgradient water quality, hydrologic, and geologic data. The installation further provides an additional regional cluster site for alluvial and Denver water quality and hydrologic monitoring.

Site EP-75

**Location:** Proposed well site EP-75 is located 2,600 ft south of the north section line and 350 ft west of the east section line of Section 23, T2S R67W.

**Rationale:** Proposed well site EP-75 will provide geologic, hydrologic, and water quality data for alluvial and Denver sands aquifers. The proposed location will monitor alluvial ground-water flow and water quality along the major contamination plume upgradient of the NBCS and will refine plume definition and contaminant characterization. Additionally, the Denver sands wells will provide chemical and stratigraphic information which will augment

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the Denver Fm investigation conducted under Task 36 by contributing upgradient water quality, hydrologic, and geologic data. The installation further provides an additional regional cluster site for alluvial and Denver water quality and hydrologic monitoring.

APPENDIX A--ONPOST WELL PRIORITY RATIONALE

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## ONPOST WELL PRIORITY RATIONALE

## ESE

Site EP-01

Proposed well site EP-01 will replace existing alluvial Well 22008 which does not fully penetrate the entire thickness of the saturated alluvium. This well has been given a secondary priority because the existing well can be used. However, a fully penetrating well would provide data for the entire zone of interest.

Site EP-01A

Proposed well site EP-01A is a secondary priority alluvial site because there are existing wells in this area that can be used for monitoring contaminant flow paths and plume definition in the southern portion of the NWBCS. However, these wells are largely of undocumented construction.

Site EP-02

Proposed well site EP-02 is a primary priority alluvial well because a good quality well which monitors the entire saturated thickness is needed to ensure that contamination does not migrate around the NWBCS. Existing wells in the area are largely of undocumented construction and do not monitor the entire thickness of saturated alluvium.

Site EP-03

Proposed well site EP-03 is a primary priority alluvial well because a good quality well which monitors the entire saturated thickness is needed to ensure that contamination does not migrate around the NWBCS. Existing wells in the area are largely of undocumented construction and do not monitor the entire thickness of saturated alluvium.

Site EP-04

Proposed well site EP-04 is a primary priority site because a fully penetrating alluvial well is needed here to better define contaminant transport in the center portion of the plume treated by the NWBCS. Existing



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Well 23160, which site EP-04 will replace, does not fully screen the entire thickness of saturated alluvium.

#### Site EP-05

Proposed well site EP-05 will replace existing alluvial Well 23013 which does not screen the entire saturated alluvium. This site is a secondary priority because primary priority has been given to installing new wells at sites deemed more critical as adequate monitoring of the contaminant plumes should be achieved with the installation of primary priority wells.

However, if after evaluating the data from primary priority sites and existing wells, it is felt that an additional site is needed to better delineate the lateral extent of the plume being treated by the NBCS, then an alluvial well at site EP-05 may be installed.

#### Site EP-06

Proposed well site EP-06 will replace existing Well 23106 which does not screen the entire thickness of saturated alluvium. This site is a secondary priority because primary priority has been given to installing new wells at sites deemed more critical as adequate monitoring of the contaminant plumes should be achieved with the installation of primary priority wells.

However, if after evaluating the water quality and hydrologic data from primary priority sites and existing wells, it is determined that an additional alluvial well is needed to better characterize the alluvial plume being treated by the NBCS, then an alluvial well may be installed at site EP-06.

#### Site EP-07

Proposed well site EP-07 will replace existing alluvial Well 24162 which does not screen the entire saturated alluvium. This site is a tertiary priority because installation will depend on evaluating the water quality and hydrologic data from the primary priority sites, as well as existing sites, and assessing whether an additional site is required to characterize the alluvial plume being treated by the NBCS.

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Site EP-08

Proposed well site EP-08 will replace existing alluvial Well 24180 which does not fully screen the saturated alluvium. This site is a secondary priority because primary priority has been given to installing new wells at sites deemed more critical to monitor the concentration and lateral extent of the contaminant plume further upgradient of the NBCS. However, if after evaluating the water quality and hydrologic data from the primary priority sites and existing wells, it is determined that a better completed alluvial well is needed to monitor contaminant concentrations immediately upgradient of the soil-bentonite barrier, then an alluvial well may be installed at site EP-08.

Site EP-09

Proposed well site EP-09 will replace existing alluvial Well 24181 which does not screen the entire saturated alluvium. This site is a tertiary priority because primary priority has been given to installing new wells at sites deemed more critical to monitor the concentration and lateral extent of the contaminant plume further upgradient of the NBCS. However, if after evaluating the water quality and hydrologic data from the primary priority sites and existing wells, it is determined that a better completed alluvial well is needed to monitor contaminant concentrations immediately upgradient of the soil-bentonite barrier, then an alluvial well may be installed at site EP-09.

Site EP-10

Proposed well site EP-10 will replace existing alluvial Well 24182 which does not screen the entire saturated alluvium. This site is a tertiary priority because primary priority has been given to installing new wells at sites deemed more critical to monitor the concentration and lateral extent of the contaminant plume further upgradient of the NBCS. However, if after evaluating the water quality and hydrologic data from the primary priority sites and existing wells, it is determined that a better completed alluvial well is needed to monitor contaminant concentrations immediately upgradient of the soil-bentonite barrier, then an alluvial well may be installed at site EP-10.

Site EP-11

Proposed well site EP-11 will replace existing Well 24115 which does not screen the entire thickness of saturated alluvium. This site is a primary priority because it is essential for the definition of the plume which is treated by the NBCS.

Site EP-12

Proposed well site EP-12 will replace existing Well 24106 which does not screen the entire thickness of saturated alluvium. This site is a tertiary priority because it is not located within the historical plume being treated by the NBCS.

Site EP-13

Proposed well site EP-13 will replace existing Well 24113 which does not screen the entire thickness of saturated alluvium. This site is a primary priority because it is essential for the definition of the plume which is treated by the NBCS. Historically, Well 24113 has given inconsistent water quality data.

Site EP-14

Proposed well site EP-14 will replace existing Well 24008 which does not screen the entire thickness of saturated alluvium. This site is a primary priority because it is essential for the definition of the plume which is treated by the NBCS. Historically, Well 24008 has given inconsistent water quality data.

Site EP-16

Proposed well site EP-16 will replace existing Well 24010 which does not screen the entire thickness of saturated alluvium. This site was a primary priority because it was needed to provide reliable hydrologic and water quality data to further define and characterize the contaminant plume between the North Plants and Basin F and the NBCS. This site has been down graded to secondary priority as a result of the installation at Site EP-74 of an alluvial, first Denver, second Denver cluster. The alluvial well at EP-74 should provide the necessary data to satisfy the EP-16 requirements.

Site EP-17

Proposed well site EP-17 is a secondary priority new alluvial well site. This site has been assigned a secondary priority because primary priority has been given to sites which are critical to monitor the historical plume being treated by the NBCS.

Site EP-18

Proposed well site EP-18 is a tertiary priority new alluvial well site. This site has been assigned a tertiary priority because higher priority has been given to sites which are critical to monitor the historical plume being treated by the NBCS. Installation will be dependant upon evaluation of water quality, hydrologic, and geologic data obtained from the alluvial well at site EP-74.

Site EP-19

The pilot corehole and first sandstone well at this site are primary priority. The pilot corehole is a primary priority because it is needed to further define the bedrock geology in this area. The first sandstone well is required to assess water quality and water levels downgradient from wells located in the same sandstone unit that are closer to the soil-bentonite barrier. Installation of a second sandstone well is a secondary priority that may need to be undertaken after evaluating the data from the first sandstone primary priority site. The first Denver installation has been downgraded to secondary priority based on the lithologic data obtained from the corehole.

Site EP-20

The pilot corehole at this site is a primary priority because it is needed to collect geologic information on the configuration of sandstone units. The installation of a first sandstone well is a secondary priority. The first sandstone wells at sites EP-21 and EP-19 are considered higher priority and will be installed first. As a result of EP-21, EP-19, and the corehole at EP-20, the data obtained indicated the need for first Denver and second Denver wells. These were assigned primary priority.

Site EP-21

Proposed well site EP-21 is for drilling a primary priority corehole and installing a primary priority first sandstone well. The corehole is needed to aid in the assessment of the configuration of the Denver sands at this location. The first sandstone well is a primary priority because it is needed to assess water quality and water levels downgradient from wells located in the same sandstone unit that are closer to the soil-bentonite barrier. Installation of a second sandstone well is a secondary priority that may need to be undertaken after evaluating the data from the first sandstone primary priority site.

Site EP-22

This site is for drilling a secondary priority pilot corehole and installation of a secondary priority first sandstone well. These activities will depend upon water quality and water level data obtained from previously installed wells at sites E-33 and E-34, which are first sandstone wells installed just to the east and west of the proposed site, respectively.

Site EP-23

Proposed well site EP-23 is for the installation of a primary priority alluvial well. This site is a primary priority because the wells within 500 ft of this site are of undocumented construction. In addition, the well is needed to provide hydrologic data to determine plume flow directions as well as water quality information for contaminant characterization upgradient of the NBCS.

Site EP-25

This site is for a secondary priority pilot corehole and first sandstone well upgradient of the NBCS. This site is a secondary priority because the activities can be more effectively undertaken after evaluating the data from drilling and well installation associated with the primary priority site EP-27. Results obtained from the EP-27 installation resulted in the assignment of primary priority to the corehole at the site.

Site EP-26

Proposed well site EP-26 is for a secondary priority pilot corehole and first sandstone well upgradient of the NBCS. This site is a secondary priority because the activities can be more effectively undertaken after evaluating the data from drilling and well installation associated with the primary priority site EP-27. The installation at EP-27 provided data which indicated that all efforts at this site be assigned primary priority.

Site EP-27

This upgradient site is for a primary priority pilot corehole and first Denver sandstone well. This drilling and installation is a primary priority because it will assist in defining geology, water quality, and hydrologic conditions in a major first sandstone unit. This well will also assist in determining points of entry for contamination into this unit. Results from drilling and sampling in the area indicated that a second Denver well was of primary priority at the site.

Site EP-28

This site is for drilling a primary priority corehole and installation of a secondary priority first Denver sandstone well. The corehole will be used to define the extent of the first sandstone in this downgradient area. The first sandstone well is a secondary priority because the need to install it will be evaluated based upon data obtained from the primary priority wells at sites EP-19 and EP-21. Results from EP-19 and EP-21 indicated that the first Denver installation be assigned primary priority.

Site EP-29

Proposed well site EP-29 has been designated as a secondary priority location. The site will be used, if necessary, to supplement the EBASCO study of the North Plants. The site will be reevaluated following a review of the Task 42 Technical Plan. Following review of the Task 42 Technical Plan, Site EP-29 was assigned primary priority.

Site EP-30

Proposed well site EP-30 has been designated as a secondary priority location. The site will be used, if necessary, to supplement the EBASCO

study of the North Plants. The site will be reevaluated following a review of the Task 42 Technical Plan.

Site EP-31

Proposed well site EP-31 has been designated as a tertiary priority location because the location supplements the proposed regional surface water study rather than satisfying a primary Task 21 objective. Additionally, it is felt that with the installation of wells at sites EP-32, EP-33, and EP-34 and the presence of existing Wells 25011, 25012, 25013, and 25014, the site may not be necessary and consequently waived. The site will be reevaluated following completion of activities at sites EP-32, EP-33, and EP-34.

Site EP-32

Proposed well site EP-32 has been designated as a secondary priority location because the site supplements the proposed regional surface water program rather than satisfying a primary Task 21 objective. The site will be reevaluated following the determination of the scope of the surface water program under Task 44.

Site EP-33

Proposed well site EP-33 has been designated as a secondary priority location because the site supplements the proposed regional surface water program rather than satisfying a primary Task 21 objective. The site will be reevaluated following the determination of the scope of the surface water program under Task 44.

Site EP-34

Proposed well site EP-34 has been designated as a secondary priority location because the site supplements the proposed regional surface water program rather than satisfying a primary Task 21 objective. The site will be reevaluated following the determination of the scope of the surface water program under Task 44.

Site EP-35

Proposed well site EP-35 has been designated as a primary priority location. The site will contribute the achievement of Task 1 primary objectives by providing upgradient ground-water monitoring in the vicinity of Basin A.

Site EP-36

Proposed well site EP-36 has been designated as a secondary priority location. The site is located in proximity to existing Wells 36075, 01008, and 01051 and possible installations under Task 26 and Task 2. These wells may be used to satisfy primary task objectives. The site will be reevaluated following a review of installations proposed and/or completed under Task 26 and Task 2.

Site EP-37

Proposed well site EP-37 has been designated as a secondary priority location. The site is located in proximity to existing Wells 36067 and 36104. These wells may be used to satisfy primary task objectives. The site will be reevaluated following a determination of source specific monitoring methodologies.

Site EP-38

Proposed well site EP-38 has been designated as a primary priority location. Installation of the well will contribute to the achievement of Task 1 primary objectives by providing downgradient monitoring in the area of Site 36-17.

Site EP-39

Proposed well site EP-39 has been designated as a secondary priority location. The site is located in proximity to recently determined existing Wells 36154 and 36155. These wells may be utilized to satisfy primary task objectives. The site will be reevaluated following a review of these wells and a determination of source specific monitoring methodologies.

Site EP-41

Proposed well site EP-41 has been designated as a primary priority location. Installation of the proposed wells will contribute to the achievement of



Task 1 primary objectives by providing a monitoring cluster in the Basin A outflow area.

Site EP-42

Proposed well site EP-42 has been designated as a tertiary priority location. The site will be used, if necessary, to supplement Task 26 activities. The site will be reevaluated following a review of Task 26 activities.

Site EP-43

Proposed well site EP-43 has been designated as a primary priority location for the completion of a corehole and a secondary priority location for the installation of a first water monitoring well. A determination of structure and stratigraphy at the site must be made prior to a decision on the well installation as the proposed location lies in an area of complex geology.

Site EP-44

Proposed well site EP-44 has been designated as a primary priority location. The site will contribute to the achievement of Task 19 primary objectives by providing a monitoring cluster to assess ground-water quality and flow between Basin B and Basin C and Basin D.

Site EP-45

Proposed well site EP-45 has been designated as a tertiary priority location. The site is located in proximity to recently determined existing Wells 26005, 26068, and 26069. These wells may be used to satisfy primary task objectives. The site will be reevaluated following a determination of source specific monitoring methodologies.

Site EP-46

Proposed well site EP-46 has been designated as a tertiary priority location. The site will be reevaluated following a determination of source specific monitoring methodologies.

Site EP-47

Proposed well site EP-47 has been designated as a primary priority location. The site will contribute to the achievement of Task 19 primary objectives by providing first water monitoring in the ground-water flow path out of Basin E.

Site EP-48

Proposed well site EP-48 has been designated as a secondary priority location. The site is located in proximity to existing Wells 26024, 26049, and 26025. These wells may be used to satisfy primary task objectives. The site will be reevaluated following a determination of source specific monitoring methodologies.

Site EP-49

Proposed well site EP-49 has been designated as a primary priority location for the completion of a corehole. Any future wells installations will be determined following evaluation of the acquired geologic and hydrologic data since the proposed location lies in an area of complex geology. The resolution of this site will contribute to the achievement of Task 19 primary objectives. Following evaluation of data obtained from other installations in the area, alluvial and first Denver installations were assigned primary priority.

Site EP-50

Proposed well site EP-50 has been designated as a secondary priority location. Existing Wells 26145, 26146, and 26147 lie in proximity to the proposed site and may be used to satisfy Task 19 primary objectives. The site will be reevaluated following a review of the existing wells.

Site EP-52

Proposed well site EP-52 has been designated a primary priority location. The site will contribute to the achievement of Task 19 primary objectives by providing a monitoring cluster in an area previously devoid of ground-water wells. Following evaluation of data obtained from the corehole, the second Denver installation was assigned secondary priority.

Site EP-53

Proposed well site EP-53 is a primary priority site for the installation of a pilot Denver corehole, an alluvial well, and two Denver wells. The installation of this cluster site is a primary priority because there are currently no cluster sites in the area, and this site will fill a significant data gap in the areal distribution of regional cluster sites. The alluvial well will monitor ground-water flow and water quality in a major alluvial contaminant pathway originating from Basin F. The Denver sand wells will provide water quality and hydrologic information which will aid in the Denver Fm investigation conducted under Task 36. The pilot corehole is a primary priority because it will provide important geologic data in the assessment of the configuration of potential water bearing units in the Denver emanating from Basin F.

Site EP-54

Proposed well site EP-54 is for the installation of a primary priority alluvial well. This site is a primary priority because it will provide a monitoring point downgradient of Basin F where existing wells are of undocumented construction. This site is also essential to the Basin F interim response action.

Site EP-55

Proposed well site EP-55 is for the installation of a primary priority alluvial well. This site is a primary priority because it will provide a monitoring point downgradient of Basin F where existing wells are of undocumented construction. This site is also essential to the Basin F interim response action.

Site EP-56

Proposed well site EP-56 is a primary priority site for the installation of a pilot Denver corehole, an alluvial well, and a Denver well. The installation of a second Denver sand well is to be determined based on an evaluation of the historical water quality of this unit. The installation of this cluster site is a primary priority because there are currently no cluster sites in the area, and this site will fill a significant data gap in the areal distribution of regional cluster sites. The alluvial well will

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monitor ground-water flow and water quality in a major alluvial contaminant pathway originating from Basin F. The first Denver sand well will provide water quality and hydrologic information which will aid in the Denver Formation investigation conducted under Task 36. The pilot corehole is a primary priority because it will provide important geologic data in the assessment of the configuration of potential water bearing units in the Denver emanating from Basin F. Results obtained from the corehole indicated that the second installation was a primary priority.

#### Site EP-59

Proposed well site EP-59 has been designated a secondary priority location. Numerous existing wells in proximity to the proposed site may be used to satisfy Task 19 primary objectives. The site will be reevaluated following a determination of source specific monitoring methodologies.

#### Site EP-62

Following a review of existing Army and Shell wells in the area the alluvial, corehole, and first Denver efforts were assigned primary priority, as additional geologic, hydrogeologic, and chemical data were required for an evaluation of the Denver Fm in the area.

#### Site EP-64

Proposed well site EP-64 is for the installation of a primary priority alluvial well. This site is a primary priority because it will fill a significant data gap in the regional alluvial monitoring network. This site is also needed to aid in the assessment of whether this location is in an area of possible confluence of two paleochannels. The site appears to be in an area of dry alluvium. As a result its priority has been downgraded to secondary.

#### Site EP-65

Proposed site EP-65 is a primary priority site for the installation of one alluvial well, two Denver wells, and the drilling of a pilot Denver corehole. This alluvial site is necessary to assess the alluvial water quality and direction of flow in a paleochannel originating from the South Plants. The Denver sand wells are needed to assess the possibility of

Denver contamination in this area of Section 34. The pilot Denver corehole is a primary priority because it will provide geologic information which will refine current bedrock interpretation and potential water bearing units in the Denver. Installation of the site will fill a significant data gap in this area.

Site EP-66

As a result of a review of existing wells in the area and the completion of the corehole the alluvial and first Denver installations have been assigned primary priority.

Site EP-67

As a result of a review of existing wells, the installation of Shell wells, and the completion of the corehole, the alluvial, first Denver, and second Denver installations have all been assigned primary priority to provide the necessary geologic, hydrogeologic, and chemical data to evaluate the Denver Fm.

Site EP-71

Proposed Site EP-71 is a secondary priority site for the installation of one alluvial well, two Denver wells, and the drilling of a pilot Denver corehole. This site is a secondary priority because primary priority has been given to those sites that are more critical for monitoring historical contaminant migration. Based upon OAS input and a review of hydrogeologic and geologic data, installations at EP-71 have been upgraded to primary priority.

Site EP-72

Proposed well site EP-72 is a primary priority site for the drilling of a pilot corehole and installation of one alluvial well and two Denver sand wells. The installation of this cluster site is a primary priority because there are currently no cluster sites in the area and this site will fill a significant data gap in the areal distribution of regional cluster sites. An alluvial well will be installed, if there is alluvial water at this site, to monitor flow that may be going around the NBCS. The Denver sand wells and pilot Denver corehole are a primary priority because they will provide

water quality, hydrologic, and geologic data which will aid in the assessment of the configuration of Denver aquifers near the NBCS that is being conducted under Task 36.

#### Site EP-74

Proposed well site EP-74 is a primary priority site for the drilling of a pilot corehole and installation of one alluvial well and two Denver sand wells. The installation of this cluster site is a primary priority because there are currently no cluster sites in the area and this site will fill a significant data gap in the areal distribution of regional cluster sites. The alluvial well is needed at this location to provide hydrologic data to determine plume flow direction, as well as water quality information for contaminant characterization upgradient of the NBCS. The Denver sand wells and pilot Denver corehole are a primary priority because they will provide water quality, hydrologic, and geologic data which will aid in the assessment of the configuration of Denver aquifers near the NBCS that is being conducted under Task 36.

#### Site EP-75

Proposed well site EP-75 is a primary priority site for the drilling of a pilot corehole and installation of one alluvial well and two Denver sand wells. The installation of this cluster site is a primary priority because there are currently no cluster sites in the area and this site will fill a significant data gap in the areal distribution of regional cluster sites. An alluvial well will be installed if there is alluvial water at this site, to monitor flow that may be going around the NBCS. The Denver sand wells and pilot Denver corehole are a primary priority because they will provide water quality, hydrologic, and geologic data which will aid in the assessment of the configuration of Denver aquifers near the NBCS that is being conducted under Task 36.

#### Site EP-76

This pilot corehole at this site was drilled to provide geologic data for cross sections to correlate sandstone units that are beneath the pilot barrier. It was anticipated that all the sandstone units that are present at the barrier would be present at this location and a cluster site could be

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installed. However, this was not the case and no wells were installed. This corehole will also provide geologic data for any future interpretive work in the Denver Fm and/or any future well installations at this site.

#### EBASCO

Due to the site specific and/or problem specific nature of the EBASCO tasks, all sites were assigned primary priority as installation of these wells contributed directly to the achievement of the respective tasks objectives.

APPENDIX B--OFFPOST WELL PRIORITY RATIONALE



## OFFPOST WELL PRIORITY RATIONALE

### Site E-32

Proposed well site E-32 is a primary priority site which is needed to assess the water quality and water flow directions of the first and second Denver sand units downgradient of the NBCS. This is a primary priority site because it is located directly downgradient of Denver dewatering Well 23342 which is suspected of being poorly completed and may provide a mechanism for cross contamination between aquifers. The pilot corehole is a primary priority because it is needed to define the extent and configuration of bedrock sand units downgradient of the NBCS.

### Site E-33

At proposed well site E-33, the pilot corehole and first Denver sandstone well are a primary priority. The well is a primary priority because there are currently no functional first sand Denver wells in this area. This well will be used to fill this hydrologic and water quality data gap. A second Denver sand well at this site is considered a tertiary priority because historically this unit has not shown significant levels of contamination relative to other units that have been identified at the NBCS. The pilot Denver corehole is a primary priority because it is needed to assess the extent and configuration of potential water bearing units in the Denver downgradient of the NBCS.

### Site E-34

At proposed well site E-34, the pilot corehole and first Denver sand well are primary priority activities. The first Denver sand well is a primary priority because there are no water quality Denver wells in service in this area. Water quality data is needed here to assess if this Denver unit is acting as a contaminant pathway beneath the NBCS. The second Denver sand well is considered a tertiary priority because historically this unit has not shown significant levels of contamination relative to other units that have been identified at the NBCS. The pilot Denver corehole is a primary priority because it will provide important geologic data in the assessment of the lateral and northerly extent of potential water bearing units in the

Denver. There are presently no Denver wells or borings in service in this area downgradient of the NBCS.

Site E-36

Proposed well site E-36 is a tertiary priority site for a possible cluster of one alluvial and two Denver wells. This site would be utilized to assess the water quality and water flow directions in the alluvium and the first and second Denver sand units identified at the site. The alluvial well is considered tertiary priority because it is a considerable distance to the east of the major alluvial contaminant plumes near the NBCS. The Denver wells are considered tertiary priority because Denver units in this area have not shown significant contamination historically.

Site E-38

Proposed well site E-38 is a primary priority site for the installation of one alluvial well, two Denver wells, and the drilling of a pilot Denver corehole. This site is necessary to assess the extent of alluvial contamination along the inferred First Creek paleochannel and the possibility of Denver contamination to the northwest of the NBCS. These installations are primary priority because they will fill a significant data gap in this area.

Site E-39

Proposed well site E-39 is a primary priority site for the installation of one alluvial well, two Denver wells, and the drilling of a pilot Denver corehole. This site is primary priority because there are currently no alluvial or Denver wells in this area and these wells are needed to assess the water quality of the alluvium and the Denver sands downgradient of the NBCS. The pilot corehole is a primary priority because it will provide important geologic data in the assessment of the lateral and northerly extent of potential water bearing units in the Denver.

Site E-40

Proposed well site E-40 is a primary priority for drilling a pilot corehole and installing one alluvial well and two Denver wells. The alluvial well will replace Well 37305 which has no construction documentation. A good

quality alluvial well is necessary at this location to help define the concentration and extent of contaminants along the First Creek paleochannel. The Denver wells are primary priority because they are needed to assess the downgradient water quality and water flow directions in Denver sand units which have been identified at the NBCS. There are presently no Denver wells in this area.

Site E-41

Proposed well site E-41 is for drilling a tertiary priority corehole and installing a secondary priority alluvial well and two tertiary priority Denver wells. The alluvial well is a secondary priority because it may be needed to assess the extent and concentration of contaminants along the First Creek paleochannel. The Denver wells and pilot corehole are a tertiary priority. The installation of these wells will be dependant upon whether specific data gaps are identified in the Denver at this location. Data gaps at this location will be most effectively identified by evaluating water quality, geologic, and hydrologic data from sites E-32 and E-40.

Site E-42

Proposed well site E-42 is a primary priority for an alluvial well because it will provide important data on the extent and concentration of contaminants to the north of First Creek. The pilot corehole and Denver wells are a tertiary priority and installation will depend on whether specific data gaps are identified by evaluating geologic, hydrologic, and water quality data from sites E-32 and E-40.

Site E-43

Proposed Site E-43 is a secondary priority site for the drilling of a pilot Denver corehole and the installation of an alluvial well. The installation of an alluvial well at this site is dependant upon water quality and hydrologic data from sites E-63, E-47, and E-74. A pilot boring at this location may be necessary to define the geology north of the eastern portion of the NBCS. The decision to drill this corehole will be made after evaluating geologic, hydrologic, and water quality data from site E-34.

Site E-44

Proposed well site E-44 is a primary priority alluvial site to assess the concentration and extent of contaminants along the First Creek paleochannel. The Denver wells are tertiary priority because their installation will depend on assessing water quality, hydrologic, and geologic data from sites E-39 and E-40.

Site E-45

Proposed well site E-45 is a secondary priority site for the drilling of a pilot corehole and the installation of two Denver wells at the site of existing alluvial Well 37323. It is a secondary priority site because the installation of these wells will depend on water quality, hydrologic, and geologic data from Denver wells at sites E-63, E-32, and E-33. A tertiary alluvial well has also been proposed for this site to replace Well 37323 which has no construction documentation. Site E-64 may be used in lieu of this site.

Site E-46

Proposed well site E-46 is a primary priority alluvial site. This site is needed to define a suspected bedrock paleochannel and determine the concentration and extent of contaminants in this area of Section 13. The pilot Denver corehole is a primary priority to define the extent and configuration of Denver sands downgradient of the NBCS. There are currently no Denver borings or wells in this area of Section 13. The Denver wells are tertiary priority and installation is dependent upon water quality, hydrologic, and geologic data obtained at sites E-63, E-33, and E-34.

Site E-47

Proposed well site E-47 is a primary priority alluvial site. This site is needed to define a suspected bedrock paleochannel and determine the concentration and extent of contaminants in this area of Section 13. The pilot Denver corehole is a primary priority to define the extent and configuration of Denver sands downgradient of the NBCS. There are currently no Denver borings or wells in this area of Section 13. The Denver wells are tertiary priority and installation is dependent upon water quality, hydrologic, and geologic data obtained at sites E-63, E-33, and E-34.

Site E-48

Proposed site E-48 is a secondary priority alluvial well that may be required to assess the lateral extent and depth of the alluvial channel, and the extent and concentration of contaminants. Installation of this well will be dependent upon evaluating data from the alluvial well at E-47.

Site E-49

Proposed well site E-49 is for installation of two Denver wells at the site of existing alluvial Well 37327. The Denver wells at this site are tertiary priority because Denver units at this location do not appear to be downgradient of significant Denver contamination associated with RMA.

Site E-50

Proposed well site E-50 is for the installation of a primary priority alluvial well. This well is needed to assess the concentration and extent of contaminants along the First Creek paleochannel. Denver wells at this site are tertiary priority because they will depend upon water quality, hydrologic, and geologic data obtained from upgradient sites.

Site E-51

Proposed well site E-51 is for the drilling of a tertiary priority pilot corehole and the installation of two tertiary priority Denver wells. Drilling of the pilot corehole and installation of the Denver wells will be dependent upon water quality, hydrologic, and geologic data obtained from upgradient sites.

Site E-52

Proposed well site E-52 will be used for the installation of one alluvial well. This well is a primary priority and is needed to define the extent of contamination in the southeast corner of Section 11 near the Boller well.

Site E-53

Proposed well site E-53 is for the drilling of a pilot corehole and the installation of one primary priority alluvial well and two tertiary priority Denver wells. The alluvial well will be used to assess the water quality, and alluvial hydrogeology upgradient of the Boller well. The Denver wells

and pilot corehole are tertiary priority and installation is dependent upon the evaluation of data collected from primary priority upgradient Denver wells.

Site E-54

Proposed well site E-54 is for the drilling of a pilot corehole and the installation of one alluvial well and two Denver wells. All activities at this site are tertiary priority. Installation of the alluvial well will depend upon the water quality and hydrogeologic data obtained from site E-76. Drilling the pilot corehole and installation of the Denver wells is dependent upon water quality and hydrogeologic data obtained from upgradient Denver wells.

Site E-55

Proposed well site E-55 is a primary priority alluvial site that will fill a data gap downgradient of the NWBCS. It will be used to assess the water quality in the offpost area between the NWBCS and production wells being proposed by SACWSD.

Site E-57

Proposed well site E-57 is for the installation of one alluvial well. This is a tertiary priority alluvial well site. Installation at this site will be dependent upon an assessment of water quality and hydrologic data at alluvial well sites E-75, E-58, E-53, E-64, and E-76.

Site E-58

Proposed well site E-58 is a primary priority alluvial site because it is needed to assess the concentration and extent of contaminants downgradient of the Boller well. Hydrologic data from this well will be used to delineate alluvial ground-water flow directions.

Site E-59

Proposed well site E-59 is for the installation of one alluvial well. This is a primary priority well. This site is necessary to define the extent and concentration of contaminants near the Boller well.

Site E-60

Site E-60 is for the installation of a tertiary priority alluvial well. This site would be utilized to help define the extent and concentration of alluvial ground-water contaminants in the area downgradient of O'Brian Canal and Burlington Ditch. This area has historically shown lower levels of contamination in comparison to the area between O'Brian Canal and the RMA north boundary. Installation of a well at this site will be dependent upon evaluation of water quality and hydrogeologic data from upgradient primary priority wells.

Site E-61

Site E-61 is for the installation of a tertiary priority alluvial well. This site would be utilized to help define the extent and concentration of alluvial ground-water contaminants in the area downgradient of O'Brian Canal and Burlington Ditch. This area has historically shown lower levels of contamination in comparison to the area between O'Brian Canal and the RMA north boundary. Installation of a well at this site will be dependent upon evaluation of water quality and hydrogeologic data from upgradient primary priority wells.

Site E-62

Site E-62 is for the installation of a secondary priority alluvial well. This site would be utilized to help define the extent and concentration of alluvial ground-water contaminants in the area downgradient of O'Brian Canal and Burlington Ditch. This area has historically shown lower levels of contamination in comparison to the area between O'Brian Canal and the RMA north boundary. Installation of a well at this site will be dependent upon evaluation of water quality and hydrogeologic data from upgradient primary priority wells.

Site E-63

Proposed site E-63 is a primary priority site for the drilling of a pilot corehole and the installation of a first Denver sand well and an alluvial well. These activities are needed to assess alluvial and Denver water quality and hydrogeology in an area downgradient of the NBCS where there is presently no monitoring or geologic information. The installation of a

second sand well at this site is considered a secondary priority because corresponding units at the NBCS have not historically shown significant contamination.

Site E-64

The alluvial well at site E-64 is a primary priority. This site is needed to assess whether a well-defined alluvial channel exists in this area and if such a channel may be acting as a primary pathway for contaminant migration to areas further north. The drilling of a pilot corehole and installation of Denver wells are tertiary priority and installation is dependent upon water quality and hydrogeologic data obtained from Denver wells upgradient.

Site E-65

The alluvial well at site E-65 is a primary priority. This well is needed to assess the extent and concentration of contaminants along the First Creek paleochannel. The drilling of a pilot corehole and installation of a first Denver sand well at this site is a secondary priority. The installation of a second Denver sand well is a tertiary priority. Denver drilling and well installation will depend upon water quality and hydrogeologic data obtained from sites E-39 and E-40.

Site E-66

Proposed well site E-66 is a primary priority and will replace Well 37332 which does not screen the entire saturated alluvium. A fully penetrating well offpost and downgradient of the NWBCS will provide more reliable water quality and hydrogeologic data to monitor the performance and operation of the system.

Site E-67

Proposed well site E-67 will replace existing Well 37334. This site is a primary priority because the existing well does not screen the entire saturated alluvium and there has recently been contamination detected in this area downgradient of the NWBCS. A fully penetrating well will provide more reliable hydrogeologic and water quality data to monitor the performance and operation of the system.



Site E-68

Proposed well site E-68 will replace existing Well 37330. The existing well does not screen the entire saturated alluvium. This site is a secondary priority because installation is dependent upon the evaluation of hydrogeologic data obtained from site E-67.

Site E-69

Proposed well site E-69 is a primary priority borehole site. This site is needed to define alluvial and Denver geology just downgradient of the NBCS. There is presently no geologic information in this area.

Site E-70

Proposed well site E-70 will replace Well 37308 which has no construction documentation. This well has been assigned a secondary priority. Primary priority has been given to those wells which are needed to fill data gaps where there are presently no wells.

Site E-71

Proposed well site E-71 will replace Well 37309 which has no construction documentation. This well has been assigned a secondary priority. Primary priority has been given to those wells which are needed to fill data gaps where there are presently no wells.

Site E-72

Proposed well site E-72 will replace Well 37313 which has no construction documentation. This well has been assigned a secondary priority. Primary priority has been given to those wells which are needed to fill data gaps where there are presently no wells.

Site E-73

Proposed well site E-73 is a primary priority alluvial site. This site is needed to define a suspected bedrock paleochannel and determine the concentration and extent of contaminants in this area of Section 13. The pilot Denver corehole is a primary priority to define the extent and configuration of Denver sands downgradient of the NBCS. There are currently

no Denver borings or wells in this area of Section 13. The Denver wells are lower priority and installation is dependent upon water quality, hydrologic and geologic data obtained at sites E-63, E-33, and E-34.

Site E-74

Proposed well site E-74 is a primary priority alluvial site. This site is needed to define a suspected bedrock paleochannel and determine the concentration and extent of contaminants in this area of Section 13. The pilot Denver corehole is a primary priority to define the extent and configuration of Denver sands downgradient of the NBCS. There are currently no Denver borings or wells in this area of Section 13. The Denver wells are lower priority and installation is dependent upon water quality, hydrologic and geologic data obtained at sites E-63, E-33, and E-34.

Site E-75

Proposed well site E-75 is for the installation of one primary priority alluvial well. This site is a primary priority. This site will be used to assess the water quality and alluvial hydrogeology upgradient of the Boller well and site E-58.

Site E-76

Proposed well site E-76 is for the installation of one primary priority alluvial well. This site is a primary priority. This site will be used to assess the water quality and alluvial hydrogeology upgradient of the Boller well and site E-58.

APPENDIX C---STATUS

# Status

CWP STATUS  
07/15/88

P/A = PLUGGED AND ABANDONED TBD = TO BE DETERMINED  
DRY = UNSATURATED ALLUVIUM

STATION	SITE	TASK	TARGET	PRIORITY	REMARKS
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CWP STATUS  
07/15/88

P/A = PLUGGED AND ABANDONED TBD = TO BE DETERMINED  
DRY = UNSATURATED ALLUVIUM

STATION	SITE	TASK	TARGET	PRIORITY	REMARKS
---------	------	------	--------	----------	---------

23218 23219	E-32	36	COREHOLE	PRIMARY	COMPLETED P/A
			1ST SAND	PRIMARY	COMPLETED
			2ND SAND	PRIMARY	COMPLETED

24191	E-33	36	COREHOLE	PRIMARY	COMPLETED P/A
			1ST SAND	PRIMARY	COMPLETED
			2ND SAND	TERTIARY	

37376	E-34	36	COREHOLE	PRIMARY	COMPLETED P/A
			1ST SAND	PRIMARY	COMPLETED
			2ND SAND	TERTIARY	

E-35	36	ELIMINATED; EXISTING COVERAGE SUFFICIENT			
------	----	--	--	--	--

E-36	39	ALLUVIAL	TERTIARY	
		COREHOLE	TERTIARY	
		1ST SAND	TERTIARY	
		2ND SAND	TERTIARY	

E-37	36	ELIMINATED; E-38,EP-71,EP-72 INSTALLED IN LIEU OF SITE			
------	----	--	--	--	--

37374 37379 37380	E-38	39	ALLUVIAL	PRIMARY	COMPLETED
			COREHOLE	PRIMARY	COMPLETED P/A
			1ST SAND	PRIMARY	COMPLETED
			2ND SAND	PRIMARY	COMPLETED

37387 37388	E-39	36	ALLUVIAL	PRIMARY	DRY P/A
			COREHOLE	PRIMARY	COMPLETED P/A
			1ST SAND	PRIMARY	COMPLETED
			2ND SAND	PRIMARY	COMPLETED

37370 37371 37372	E-40	36	ALLUVIAL	PRIMARY	COMPLETED
			COREHOLE	PRIMARY	COMPLETED P/A
			1ST SAND	PRIMARY	COMPLETED
			2ND SAND	PRIMARY	COMPLETED

CWP STATUS  
07/15/88

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STATION	SITE	TASK	TARGET	PRIORITY	REMARKS
	E-41	36	ALLUVIAL COREHOLE 1ST SAND 2ND SAND	SECONDARY TERTIARY TERTIARY TERTIARY	
37369	E-42	36	ALLUVIAL COREHOLE 1ST SAND 2ND SAND	PRIMARY TERTIARY TERTIARY TERTIARY	COMPLETED
	E-43	39	ALLUVIAL COREHOLE 1ST SAND	SECONDARY TERTIARY TERTIARY	
37373 37398 37399	E-44	39	ALLUVIAL  COREHOLE 1ST SAND 2ND SAND	PRIMARY PRIMARY PRIMARY TERTIARY TERTIARY TERTIARY	COMPLETED; AQUIFER TEST COMPLETED; OBSERVATION WELL COMPLETED; OBSERVATION WELL
	E-45	39	ALLUVIAL COREHOLE 1ST SAND 2ND SAND	TERTIARY TERTIARY TERTIARY TERTIARY	
37377	E-46	39	ALLUVIAL COREHOLE 1ST SAND 2ND SAND	PRIMARY PRIMARY TERTIARY TERTIARY	COMPLETED COMPLETED P/A
37378	E-47	39	ALLUVIAL COREHOLE 1ST SAND 2ND SAND	PRIMARY PRIMARY TERTIARY TERTIARY	COMPLETED
	E-48	39	ALLUVIAL	SECONDARY	
	E-49	39	COREHOLE 1ST SAND 2ND SAND	TERTIARY TERTIARY TERTIARY	

CNP STATUS  
07/15/88

P/A = PLUGGED AND ABANDONED    TBD = TO BE DETERMINED  
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STATION	SITE	TASK	TARGET	PRIORITY	REMARKS
37396	E-50	39	ALLUVIAL COREHOLE 1ST SAND	PRIMARY TERTIARY TERTIARY	COMPLETED
	E-51	39	COREHOLE 1ST SAND 2ND SAND	TERTIARY TERTIARY TERTIARY	
37397	E-52	39	ALLUVIAL	PRIMARY	COMPLETED
37367	E-53	39	ALLUVIAL	PRIMARY	COMPLETED; AQUIFER TEST
37400				PRIMARY	COMPLETED; OBSERVATION WELL
37401				PRIMARY	COMPLETED; OBSERVATION WELL
			COREHOLE 1ST SAND 2ND SAND	TERTIARY TERTIARY TERTIARY	
	E-54	39	ALLUVIAL COREHOLE 1ST SAND 2ND SAND	TERTIARY TERTIARY TERTIARY TERTIARY	
37382	E-55	25	ALLUVIAL	PRIMARY	COMPLETED
	E-56	39			ELIMINATED; E-38, EP-71, EP-72 INSTALLED IN LIEU OF SITE
	E-57	39	ALLUVIAL	TERTIARY	
37368	E-58	39	ALLUVIAL	PRIMARY	COMPLETED
37395	E-59	39	ALLUVIAL	PRIMARY	COMPLETED
	E-60	39	ALLUVIAL	TERTIARY	
	E-61	39	ALLUVIAL	TERTIARY	

CWP STATUS  
07/15/88

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STATION	SITE	TASK	TARGET	PRIORITY	REMARKS
	E-62	39	ALLUVIAL	SECONDARY	
37389	E-63	36	ALLUVIAL	PRIMARY	COMPLETED
			COREHOLE	PRIMARY	COMPLETED P/A
37390			1ST SAND	PRIMARY	COMPLETED
			2ND SAND	PRIMARY	
	E-64	39	ALLUVIAL	PRIMARY	DRY P/A
			COREHOLE	TERTIARY	
			1ST SAND	TERTIARY	
			2ND SAND	TERTIARY	
37381	E-65	39	ALLUVIAL	PRIMARY	COMPLETED
			COREHOLE	SECONDARY	
			1ST SAND	SECONDARY	
			2ND SAND	TERTIARY	
37386	E-66	25	ALLUVIAL	PRIMARY	COMPLETED
37385	E-67	25	ALLUVIAL	PRIMARY	COMPLETED
	E-68	25	ALLUVIAL	SECONDARY	
	E-69	36	COREHOLE	PRIMARY	COMPLETED P/A
	E-70	39	ALLUVIAL	SECONDARY	
	E-71	39	ALLUVIAL	SECONDARY	
	E-72	39	ALLUVIAL	SECONDARY	
37391	E-73	39	ALLUVIAL	PRIMARY	COMPLETED
			COREHOLE	PRIMARY	COMPLETED P/A
			1ST SAND	SECONDARY	
			2ND SAND	TERTIARY	
37392	E-74	39	ALLUVIAL	PRIMARY	COMPLETED
			COREHOLE	PRIMARY	COMPLETED P/A
			1ST SAND	SECONDARY	
			2ND SAND	TERTIARY	

CWP STATUS  
07/15/88

PVA = PLUGGED AND ABANDONED    TBD = TO BE DETERMINED  
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STATION	SITE	TASK	TARGET	PRIORITY	REMARKS
	E-75	39	ALLUVIAL	PRIMARY	DRY PVA
37383	E-76	39	ALLUVIAL	PRIMARY	COMPLETED
	EP-01	25	ALLUVIAL	SECONDARY	
	EP-01A	25	ALLUVIAL	SECONDARY	
27085	EP-02	25	ALLUVIAL	PRIMARY	COMPLETED
27086	EP-03	25	ALLUVIAL	PRIMARY	COMPLETED
23231	EP-04	25	ALLUVIAL	PRIMARY	COMPLETED
	EP-05	25	ALLUVIAL	SECONDARY	
	EP-06	25	ALLUVIAL	SECONDARY	
	EP-07	25	ALLUVIAL	TERTIARY	
	EP-08	25	ALLUVIAL	SECONDARY	
	EP-09	25	ALLUVIAL	TERTIARY	
	EP-10	25	ALLUVIAL	TERTIARY	
24199	EP-11	25	ALLUVIAL	PRIMARY	COMPLETED
	EP-12	25	ALLUVIAL	TERTIARY	
24200	EP-13	25	ALLUVIAL	PRIMARY	COMPLETED
24201	EP-14	25	ALLUVIAL	PRIMARY	COMPLETED
	EP-15	25			ELIMINATED; COMBINED WITH EP-74 CLUSTER
	EP-16	25	ALLUVIAL	SECONDARY	
	EP-17	25	ALLUVIAL	SECONDARY	
	EP-18	25	ALLUVIAL	TERTIARY	



CWP STATUS  
07/15/88

P/A = PLUGGED AND ABANDONED TBO = TO BE DETERMINED  
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STATION	SITE	TASK	TARGET	PRIORITY	REMARKS
	EP-19	36	ALLUVIAL COREHOLE 1ST SAND 2ND SAND	SECONDARY PRIMARY SECONDARY SECONDARY	COMPLETED P/A
23226 23236	EP-20	36	ALLUVIAL COREHOLE 1ST SAND 2ND SAND	TERTIARY PRIMARY PRIMARY PRIMARY	COMPLETED P/A COMPLETED COMPLETED
23235	EP-21	36	ALLUVIAL COREHOLE 1ST SAND 2ND SAND	TERTIARY PRIMARY PRIMARY SECONDARY	COMPLETED P/A COMPLETED
	EP-22	36	ALLUVIAL COREHOLE 1ST SAND 2ND SAND	SECONDARY SECONDARY SECONDARY TERTIARY	
23232	EP-23	25	ALLUVIAL	PRIMARY	COMPLETED
	EP-24	25	ALLUVIAL		ELIMINATED; EP-04 INSTALLED IN LIEU OF SITE
	EP-25	36	COREHOLE 1ST SAND	PRIMARY SECONDARY	
23233 23234	EP-26	36	COREHOLE 1ST SAND 2ND SAND	PRIMARY PRIMARY PRIMARY	COMPLETED P/A COMPLETED COMPLETED
23227 23228	EP-27	36	COREHOLE 1ST SAND 2ND SAND	PRIMARY PRIMARY PRIMARY	COMPLETED P/A COMPLETED COMPLETED
	EP-28	36	ALLUVIAL COREHOLE 1ST SAND	SECONDARY PRIMARY PRIMARY	COMPLETED P/A
25048	EP-29	21	ALLUVIAL	PRIMARY	COMPLETED
	EP-30	21	ALLUVIAL	SECONDARY	
	EP-31	21	ALLUVIAL	TERTIARY	

CWP STATUS  
07/15/88

P/A = PLUGGED AND ABANDONED    TBD = TO BE DETERMINED  
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STATION	SITE	TASK	TARGET	PRIORITY	REMARKS
	EP-33	21	ALLUVIAL	SECONDARY	
			ALLUVIAL	SECONDARY	
			COREHOLE	SECONDARY	
			1ST SAND	SECONDARY	
	EP-32	21	ALLUVIAL	SECONDARY	
	EP-34	21	ALLUVIAL	SECONDARY	
36181	EP-35	1	ALLUVIAL	PRIMARY	COMPLETED
			COREHOLE	PRIMARY	COMPLETED P/A
36182			1ST SAND	PRIMARY	COMPLETED
36183			2ND SAND	PRIMARY	COMPLETED
	EP-36	1	ALLUVIAL	SECONDARY	
	EP-37	1	ALLUVIAL	SECONDARY	
36180	EP-38	1	ALLUVIAL	PRIMARY	COMPLETED
	EP-39	1	ALLUVIAL	SECONDARY	
	EP-40	1			ELIMINATED; EXISTING COVERAGE SUFFICIENT
36177	EP-41	1	ALLUVIAL	PRIMARY	COMPLETED
			COREHOLE	PRIMARY	COMPLETED P/A
36178			1ST SAND	PRIMARY	COMPLETED
36179			2ND SAND	PRIMARY	COMPLETED
	EP-42	19	ALLUVIAL	TERTIARY	
	EP-43	19	COREHOLE	PRIMARY	COMPLETED P/A
26150			1ST SAND	PRIMARY	COMPLETED
	EP-44	19	COREHOLE	PRIMARY	COMPLETED P/A
26154			ALLUVIAL	PRIMARY	COMPLETED
26151			1ST SAND	PRIMARY	COMPLETED
26152			2ND SAND	PRIMARY	COMPLETED
	EP-45	19	1ST H2O	SECONDARY	
	EP-46	19	1ST H2O	SECONDARY	
27084	EP-47	19	1ST H2O	PRIMARY	COMPLETED

CWP STATUS  
07/15/88

P/A = PLUGGED AND ABANDONED TBD = TO BE DETERMINED  
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STATION	SITE	TASK	TARGET	PRIORITY	REMARKS
	EP-48	19	1ST H2O	SECONDARY	
	EP-49	19	COREHOLE	PRIMARY	COMPLETED P/A B1; INSTLLN @ B2
26155			1ST SAND	PRIMARY	COMPLETED
26156			2ND SAND	PRIMARY	COMPLETED
	EP-50	19	COREHOLE	SECONDARY	
			1ST H2O	SECONDARY	
			1ST SAND	SECONDARY	
			2ND SAND	SECONDARY	
	EP-51	19	ELIMINATED; EP-52 INSTALLED IN LIEU OF SITE		
	EP-52	19	COREHOLE	PRIMARY	COMPLETED P/A
26149			1ST SAND	PRIMARY	COMPLETED
			2ND SAND	SECONDARY	
23220	EP-53	44	ALLUVIAL	PRIMARY	COMPLETED
			COREHOLE	PRIMARY	COMPLETED P/A
23221			1ST SAND	PRIMARY	COMPLETED
23222			2ND SAND	PRIMARY	COMPLETED
26148	EP-54	44	ALLUVIAL	PRIMARY	COMPLETED
	EP-55	44	ALLUVIAL	PRIMARY	DRY P/A
	EP-56	44	ALLUVIAL	PRIMARY	DRY P/A
			COREHOLE	PRIMARY	COMPLETED P/A
26153			1ST SAND	SECONDARY	
			2ND SAND	PRIMARY	COMPLETED
	EP-57	44	ELIMINATED; EP-56 INSTALLED IN LIEU OF SITE		
	EP-58	44	ELIMINATED; EXISTING COVERAGE SUFFICIENT		
	EP-59	19	1ST H2O	SECONDARY	
	EP-60	44	ELIMINATED; COMBINED WITH EP-49		
	EP-61	44	ELIMINATED; EXISTING CLUSTER ADEQUATE FOLLOWING REVIEW		
	EP-62	44	ALLUVIAL	PRIMARY	DRY P/A
			COREHOLE	PRIMARY	COMPLETED P/A
34011			1ST SAND	PRIMARY	COMPLETED
			2ND SAND	TBD	

CWP STATUS  
07/15/88

P/A = PLUGGED AND ABANDONED    TBD = TO BE DETERMINED  
DRY = UNSATURATED ALLUVIUM

STATION	SITE	TASK	TARGET	PRIORITY	REMARKS
=====					
	EP-63	44			ELIMINATED; EXISTING CLUSTER ADEQUATE FOLLOWING REVIEW
=====					
	EP-64	44	ALLUVIAL	SECONDARY	
=====					
	EP-65	44	ALLUVIAL	PRIMARY	DRY P/A
			COREHOLE	PRIMARY	COMPLETED P/A
34012			1ST SAND	PRIMARY	COMPLETED
34013			2ND SAND	PRIMARY	COMPLETED
=====					
	EP-66	44	ALLUVIAL	PRIMARY	DRY P/A
			COREHOLE	PRIMARY	COMPLETED P/A
03012			1ST SAND	PRIMARY	COMPLETED
			2ND SAND	SECONDARY	
=====					
35087	EP-67	44	ALLUVIAL	PRIMARY	COMPLETED
			COREHOLE	PRIMARY	COMPLETED P/A
35088			1ST SAND	PRIMARY	COMPLETED
35089			2ND SAND	PRIMARY	COMPLETED
=====					
	EP-68	44			ELIMINATED; NOT REQUIRED FOR CURRENT STUDY
=====					
	EP-69	44			ELIMINATED; NOT REQUIRED FOR CURRENT STUDY
=====					
	EP-70	44			ELIMINATED; NOT REQUIRED FOR CURRENT STUDY
=====					
	EP-71	44	ALLUVIAL	PRIMARY	DRY P/A
			COREHOLE	PRIMARY	COMPLETED P/A
22079			1ST SAND	PRIMARY	COMPLETED
22080			2ND SAND	PRIMARY	COMPLETED
=====					
	EP-72	44	ALLUVIAL	PRIMARY	DRY P/A
			COREHOLE	PRIMARY	COMPLETED P/A
23229			1ST SAND	PRIMARY	COMPLETED
23230			2ND SAND	PRIMARY	COMPLETED
=====					
	EP-73	44			ELIMINATED; COMBINED WITH EP-53
=====					
24196	EP-74	44	ALLUVIAL	PRIMARY	COMPLETED
			COREHOLE	PRIMARY	COMPLETED P/A
24197			1ST SAND	PRIMARY	COMPLETED
24198			2ND SAND	PRIMARY	COMPLETED
=====					
23223	EP-75	44	ALLUVIAL	PRIMARY	COMPLETED
			COREHOLE	PRIMARY	COMPLETED P/A
23224			1ST SAND	PRIMARY	COMPLETED
23225			2ND SAND	PRIMARY	COMPLETED
=====					

CWP STATUS  
08/25/88

PVA = PLUGGED AND ABANDONED    TBD = TO BE DETERMINED  
DRY = UNSATURATED ALLUVIUM

STATION	SITE	TASK	TARGET	PRIORITY	REMARKS
=====					
	EP-76	36	COREHOLE	PRIMARY	COMPLETED PVA
			1ST SAND	SECONDARY	
			2ND SAND	SECONDARY	
			3RD SAND	SECONDARY	
=====					
PIEZOMETERS		36	ALLUVIAL	PRIMARY	COMPLETED
23212	P-3				
23213	P-5				
23214	P-7				
23215	P-8				
23216	P-10				
23217	P-12				
24192	P-14				
24193	P-16				
24194	P-17				
24195	P-18				
=====					
01701	HSBF-1	11	ALLUVIAL	PRIMARY	COMPLETED
=====					
01702	HSBF-2	11	ALLUVIAL	PRIMARY	COMPLETED
=====					
05004	S-2	22	ALLUVIAL	PRIMARY	COMPLETED
=====					
	S-1	26	DENVER	PRIMARY	
=====					
35077	S-2	26	DENVER	PRIMARY	COMPLETED
=====					
	S-3	26	DENVER	PRIMARY	
=====					
	S-4	26	DENVER	PRIMARY	
=====					
35079	S-5	26	ALLUVIAL	PRIMARY	COMPLETED
35081	-6		ALLUVIAL	PRIMARY	COMPLETED
35080	-7		DENVER	PRIMARY	COMPLETED
	-8		DENVER	PRIMARY	
=====					
35159	S-9	26	ALLUVIAL	PRIMARY	COMPLETED
	-10		DENVER	PRIMARY	
	-11		DENVER	PRIMARY	
=====					
35158	S-12	26	ALLUVIAL	PRIMARY	COMPLETED
=====					
35083	S-13	26	DENVER	PRIMARY	COMPLETED
35084	-14		DENVER	PRIMARY	COMPLETED
=====					

CWP STATUS  
08/25/89

P/A = PLUGGED AND ABANDONED T/D = TO BE DETERMINED  
DRY = UNSATURATED ALLUVIUM

STATION	SITE	TASK	TARGET	PRIORITY	REMARKS
=====					
02050	S-15	26	ALLUVIAL	PRIMARY	COMPLETED
=====					
02052	S-16	26	ALLUVIAL	PRIMARY	COMPLETED
=====					
01069	S-17	26	ALLUVIAL	PRIMARY	COMPLETED
=====					
01070	S-18	26	ALLUVIAL	PRIMARY	COMPLETED
=====					
33076	WT33-1	38	ALLUVIAL	PRIMARY	COMPLETED
=====					
33077	WT33-2	38	ALLUVIAL	PRIMARY	COMPLETED
33078			ALLUVIAL	PRIMARY	COMPLETED
33079			ALLUVIAL	PRIMARY	COMPLETED
=====					
33074	WT33-3	38	ALLUVIAL	PRIMARY	COMPLETED
33075			ALLUVIAL	PRIMARY	COMPLETED
=====					
04038	WT4-1	38	ALLUVIAL	PRIMARY	COMPLETED
04039			ALLUVIAL	PRIMARY	COMPLETED
=====					
04037	WT4-2	38	ALLUVIAL	PRIMARY	COMPLETED
=====					
04045	WT4-3	38	ALLUVIAL	PRIMARY	COMPLETED
04046			ALLUVIAL	PRIMARY	COMPLETED
04047			ALLUVIAL	PRIMARY	COMPLETED
=====					
04040	WT4-4	38	ALLUVIAL	PRIMARY	COMPLETED
=====					
04044	WT4-5	38	ALLUVIAL	PRIMARY	COMPLETED
=====					
04036	WT4-6	38	ALLUVIAL	PRIMARY	COMPLETED
=====					
04030	WT4-7	38	ALLUVIAL	PRIMARY	COMPLETED
=====					
04031	WT4-8	38	ALLUVIAL	PRIMARY	COMPLETED
=====					
04032	WT4-9	38	ALLUVIAL	PRIMARY	COMPLETED
=====					
04033	WT4-10	38	ALLUVIAL	PRIMARY	COMPLETED
=====					
04035	WT4-11	38	ALLUVIAL	PRIMARY	COMPLETED
=====					
04041	WT4-12	38	ALLUVIAL	PRIMARY	COMPLETED
=====					

CWP STATUS  
08/25/88

P/A = PLUGGED AND ABANDONED    TBD = TO BE DETERMINED  
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STATION	SITE	TASK	TARGET	PRIORITY	REMARKS
=====					
04042	WT4-13	38	ALLUVIAL	PRIMARY	COMPLETED
04043			ALLUVIAL	PRIMARY	COMPLETED
=====					
03011	WT3-1	38	ALLUVIAL	PRIMARY	COMPLETED
=====					
09010	WT9-1	38	ALLUVIAL	PRIMARY	COMPLETED
=====					
09011	WT9-2	38	ALLUVIAL	PRIMARY	COMPLETED
09012			ALLUVIAL	PRIMARY	COMPLETED
=====					
	WT9-3	38	ALLUVIAL	PRIMARY	
=====					
09008	WT9-4	38	ALLUVIAL	PRIMARY	COMPLETED
09009			ALLUVIAL	PRIMARY	COMPLETED
=====					
09013	WT9-5	38	ALLUVIAL	PRIMARY	COMPLETED
09014			ALLUVIAL	PRIMARY	COMPLETED
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APPENDIX D--DEEP WELL METHODOLOGY



07/19/88

## DEEP WELL METHODOLOGY

One of the objectives of the RMA Remedial Investigation was to define the maximum vertical extent of ground-water contamination. This was accomplished to a limited degree by interpretation of existing ground-water monitoring wells. In many areas of RMA the sampling of the deepest existing monitoring wells resulted in the detection of inorganic and/or organic constituents.

The Composite Well Program was devised to provide a mechanism to select, prioritize, and install additional ground-water monitoring wells that would delineate the areal and vertical extent of contamination. With respect to definition of the vertical extent of contamination, the Composite Well Program identified locations where RMA contaminants were detected in the lowest available Denver Fm wells in source and plume areas. Based on this information a priority for the installation of deeper wells was established.

During the process by which locations and depths for additional monitoring wells were selected, the contractor teams developed a formalized approach to the delineation of the vertical extent of ground-water contamination. The strategy developed during the design and implementation of the Composite Well Program is shown in the flowchart presented as Figure D-1. Although this procedure could not be strictly followed during the execution of the Composite Well Program, the concept of defining the vertical extent of contamination with the use of additional monitoring wells was established.

Ground-water monitoring wells installed in cluster configurations were constructed in most of the major source and plume areas. Specifically deep monitoring wells were installed in the vicinity of the NBCS (Sections 23 and 24), the NWBCS (Section 22), Basin A (Section 36), Basins B through F (Sections 35 and 26), and the offpost area. After water quality data resulting from the sampling of these wells is available, the need for the installation of deeper wells at these locations will be assessed.

The purpose of efforts directed towards installation of deeper wells during the Composite Well Program was to provide information to fill significant

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data deficiencies perceived to be required to complete the Remedial Investigation. Additional refinement of the vertical distribution of RMA contaminants in the Denver Fm is not perceived to be data necessary to complete the Remedial Investigation, but may be data required for the completion of the Feasibility Study. During these efforts the process shown in the flow chart (Figure D-1) will be used to identify locations for deeper wells.

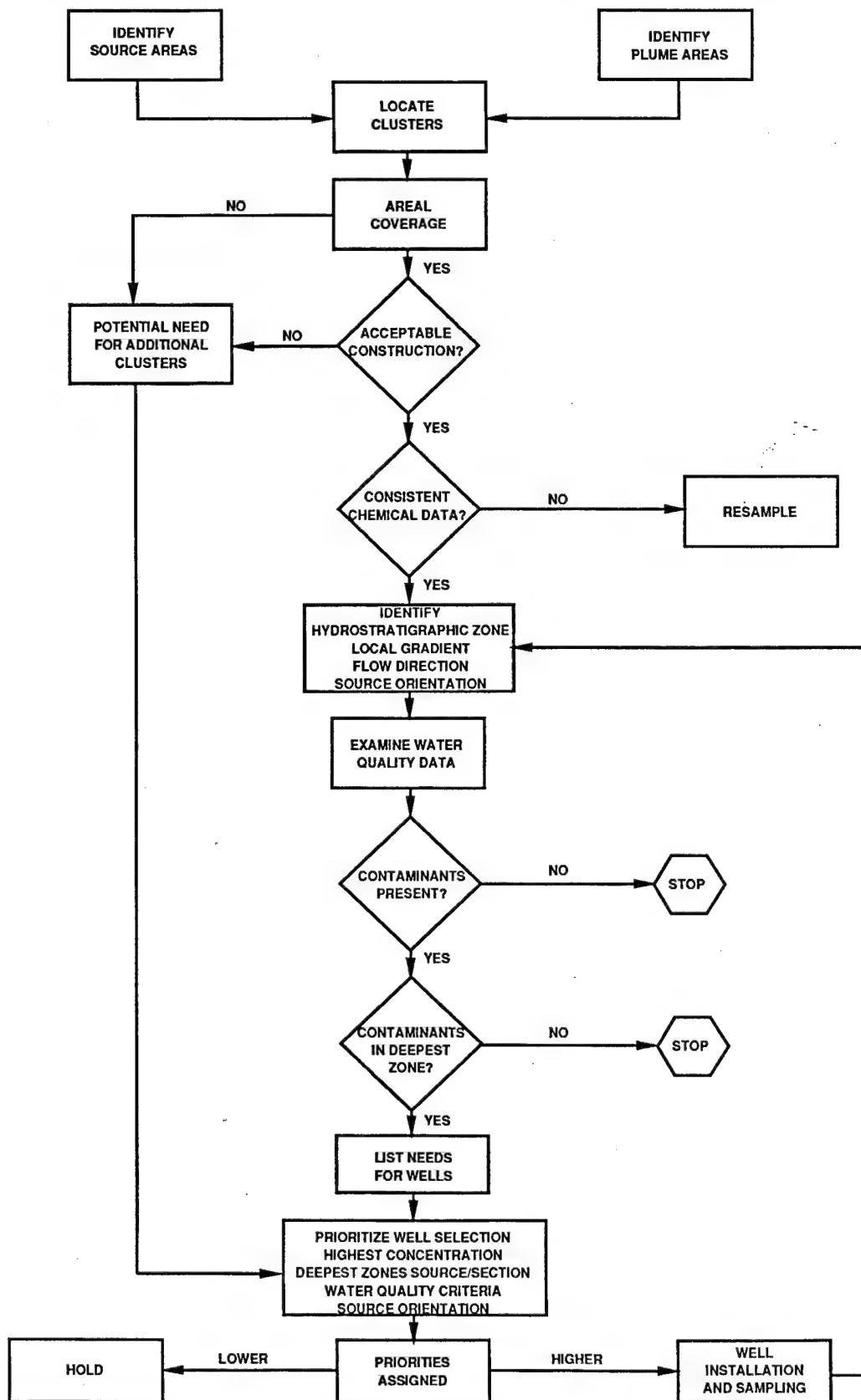


Figure D-1  
EVALUATION OF WELL NETWORK TO  
IDENTIFY THE NEED FOR DEEP WELLS

SOURCE: ESE, 1987

Prepared for:  
U.S. Army Program Manager's Office  
For Rocky Mountain Arsenal

Aberdeen Proving Ground, Maryland

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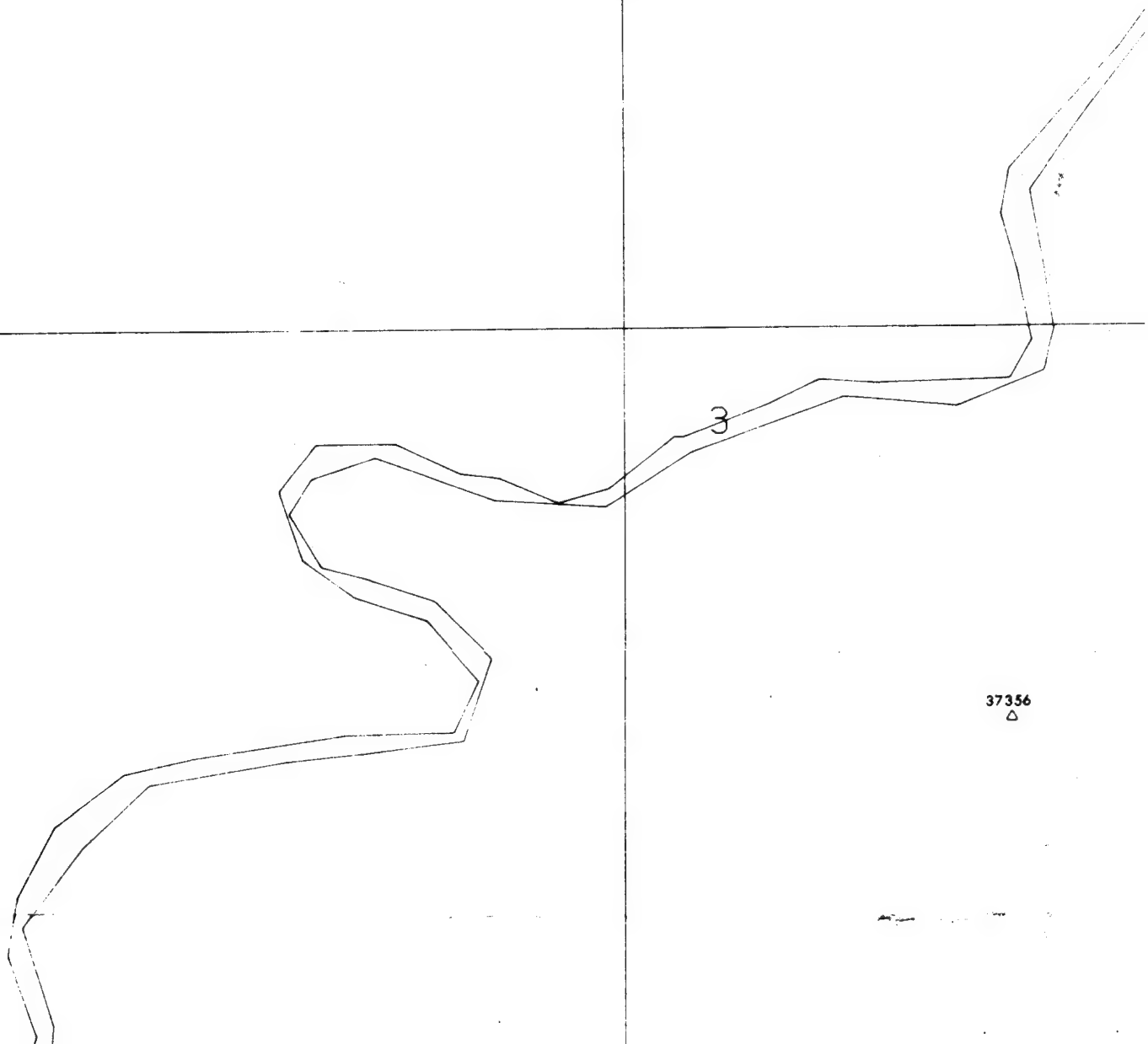
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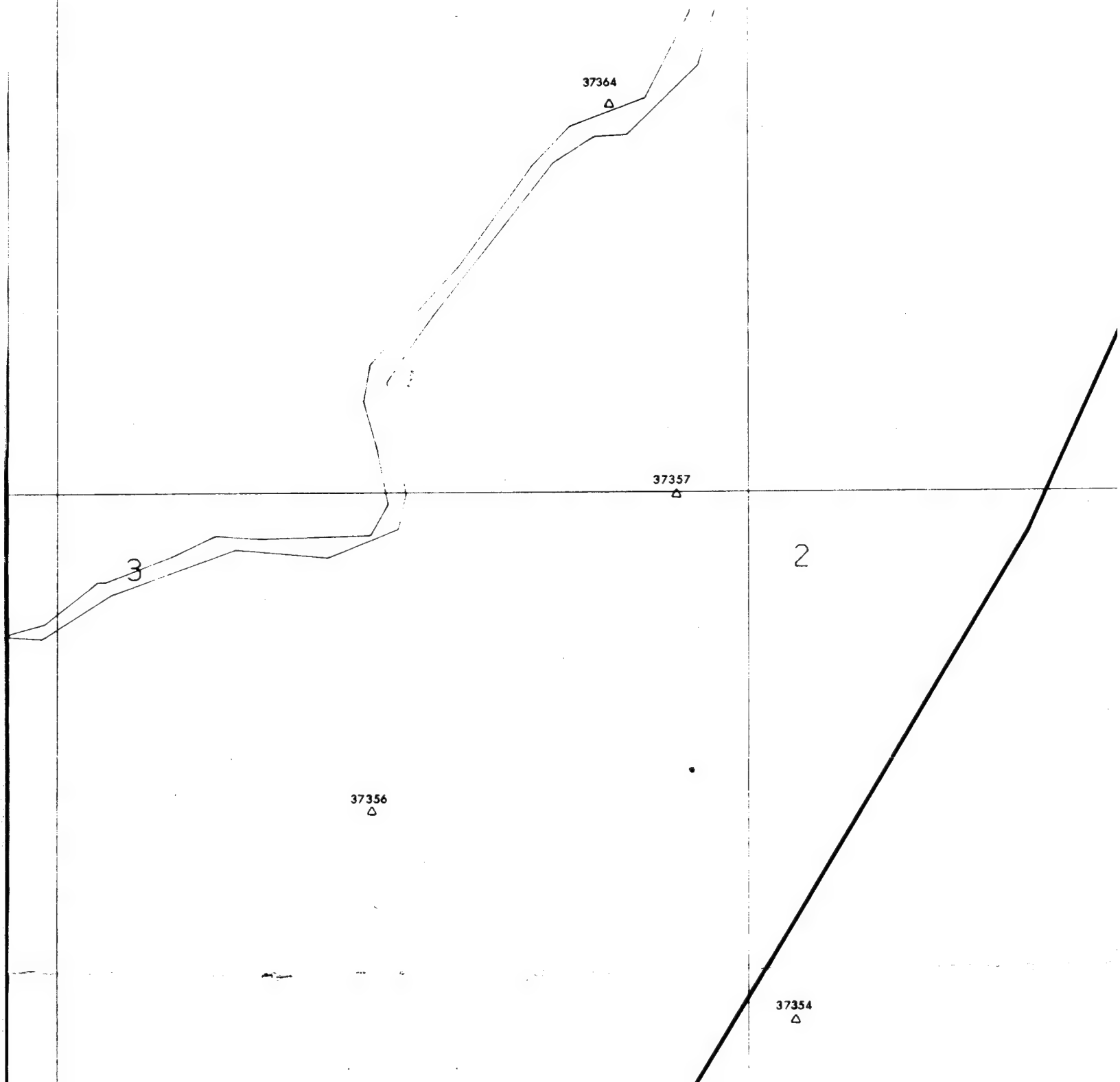
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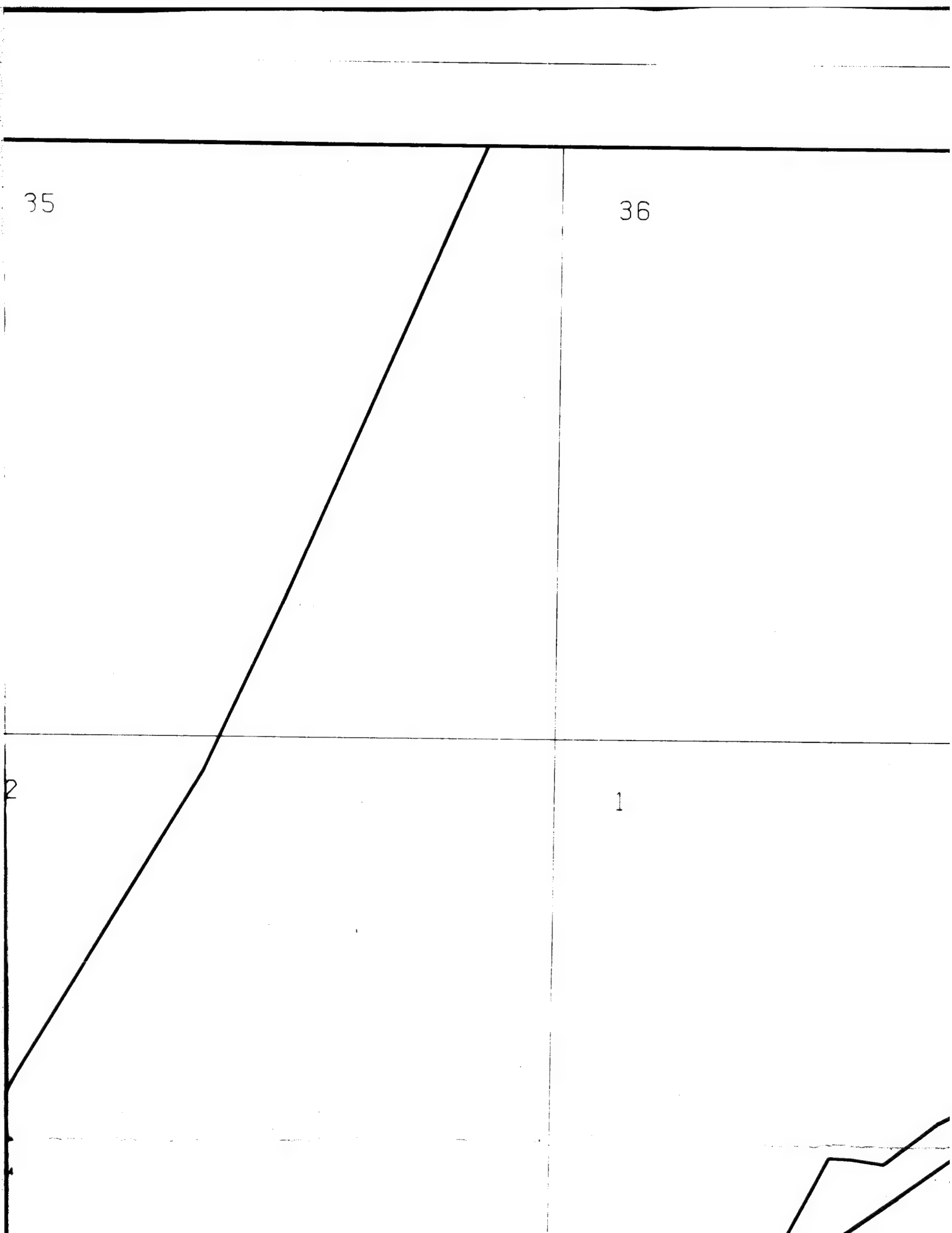
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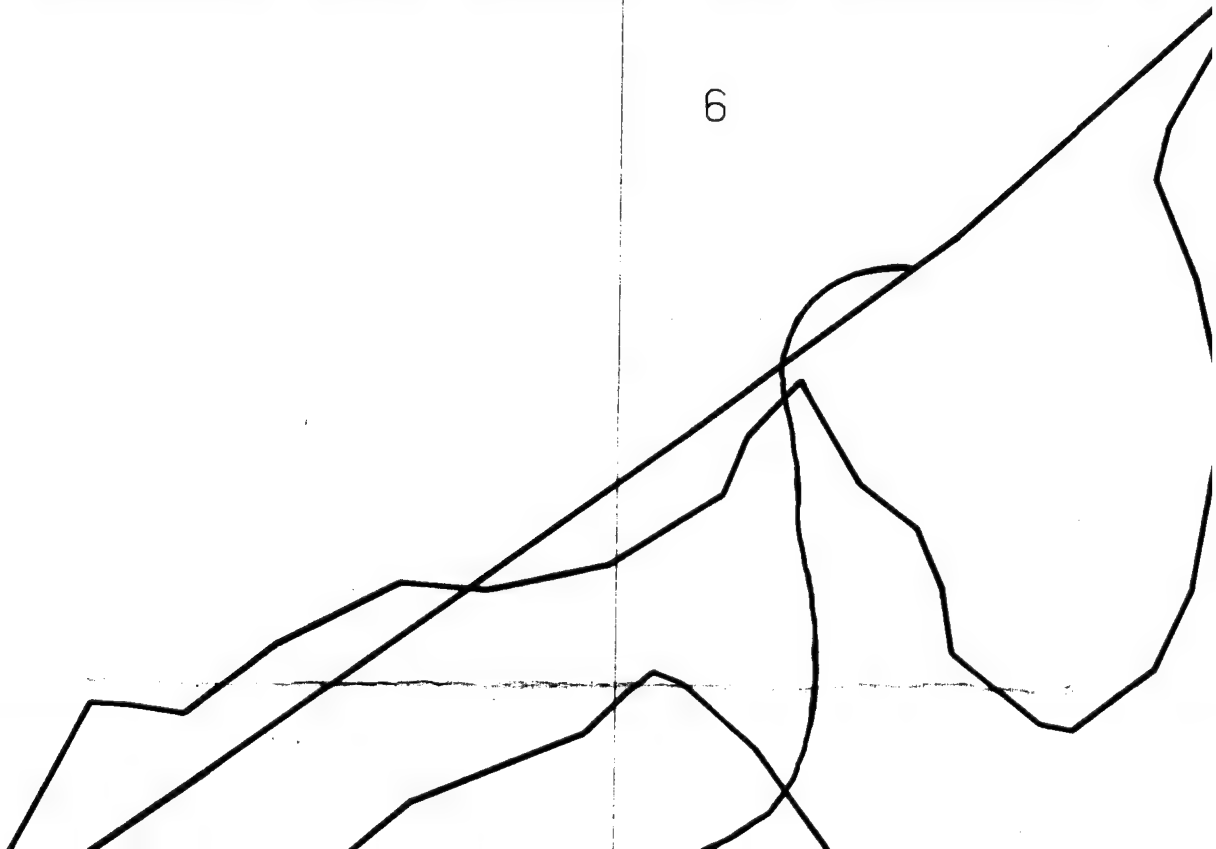


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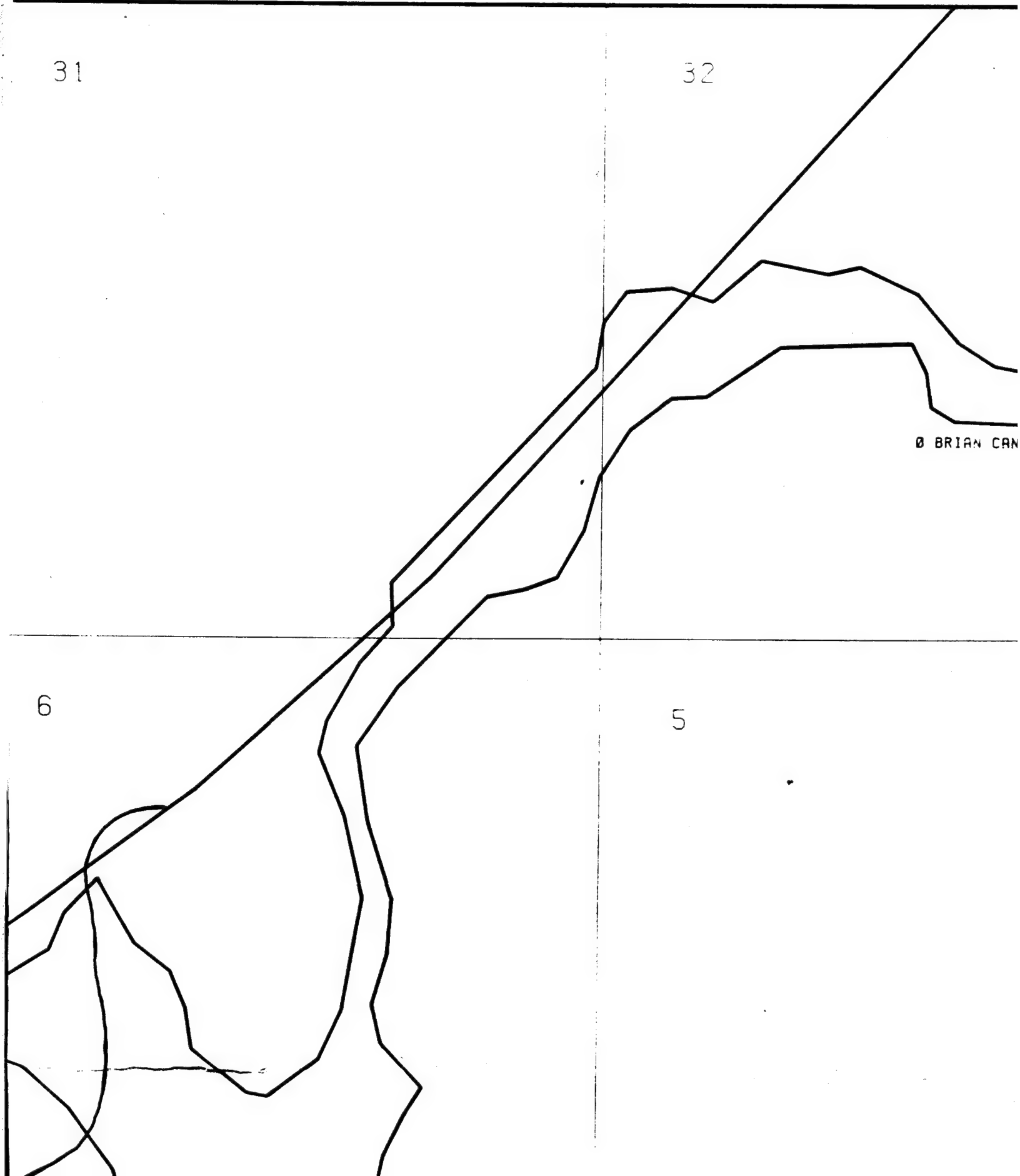
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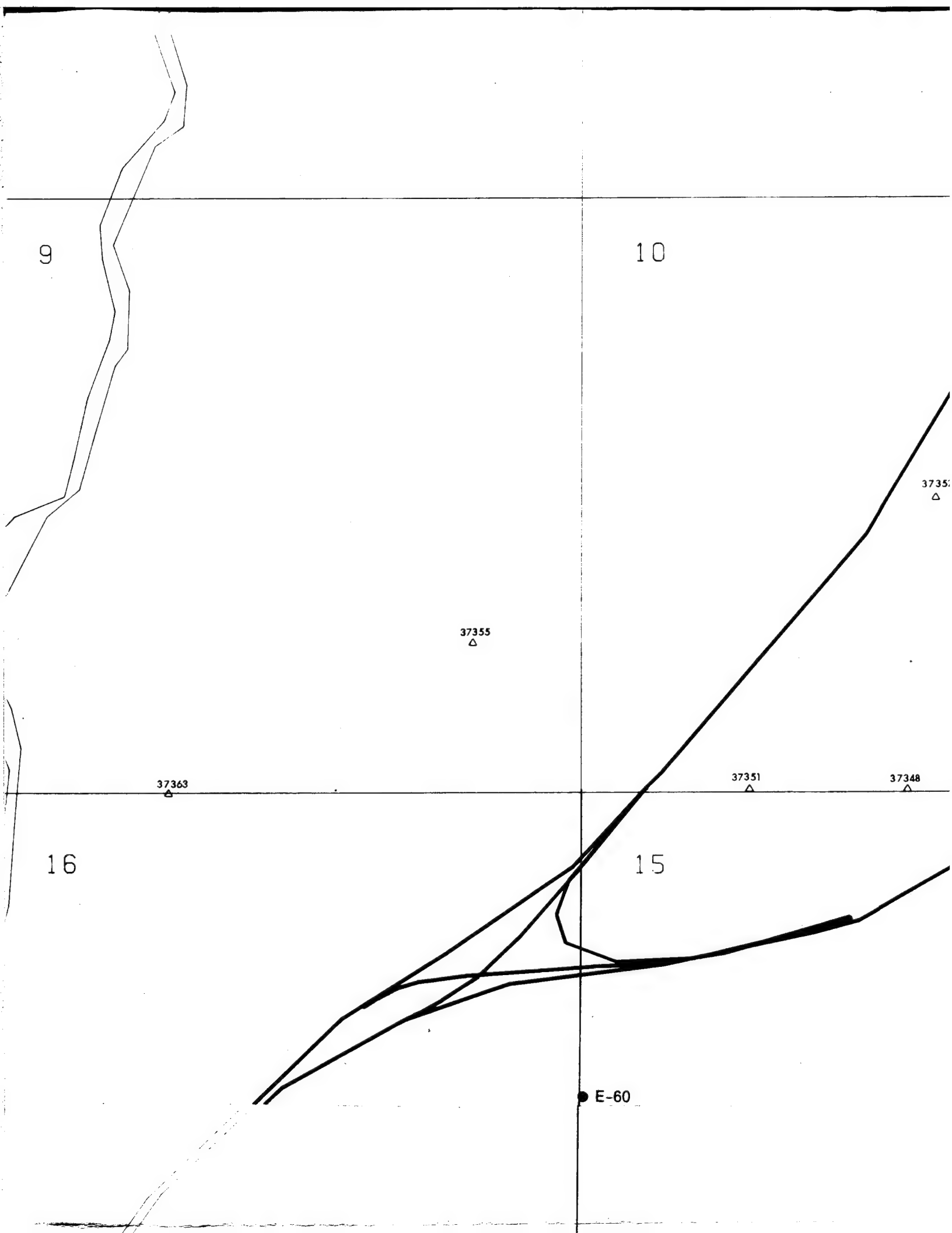
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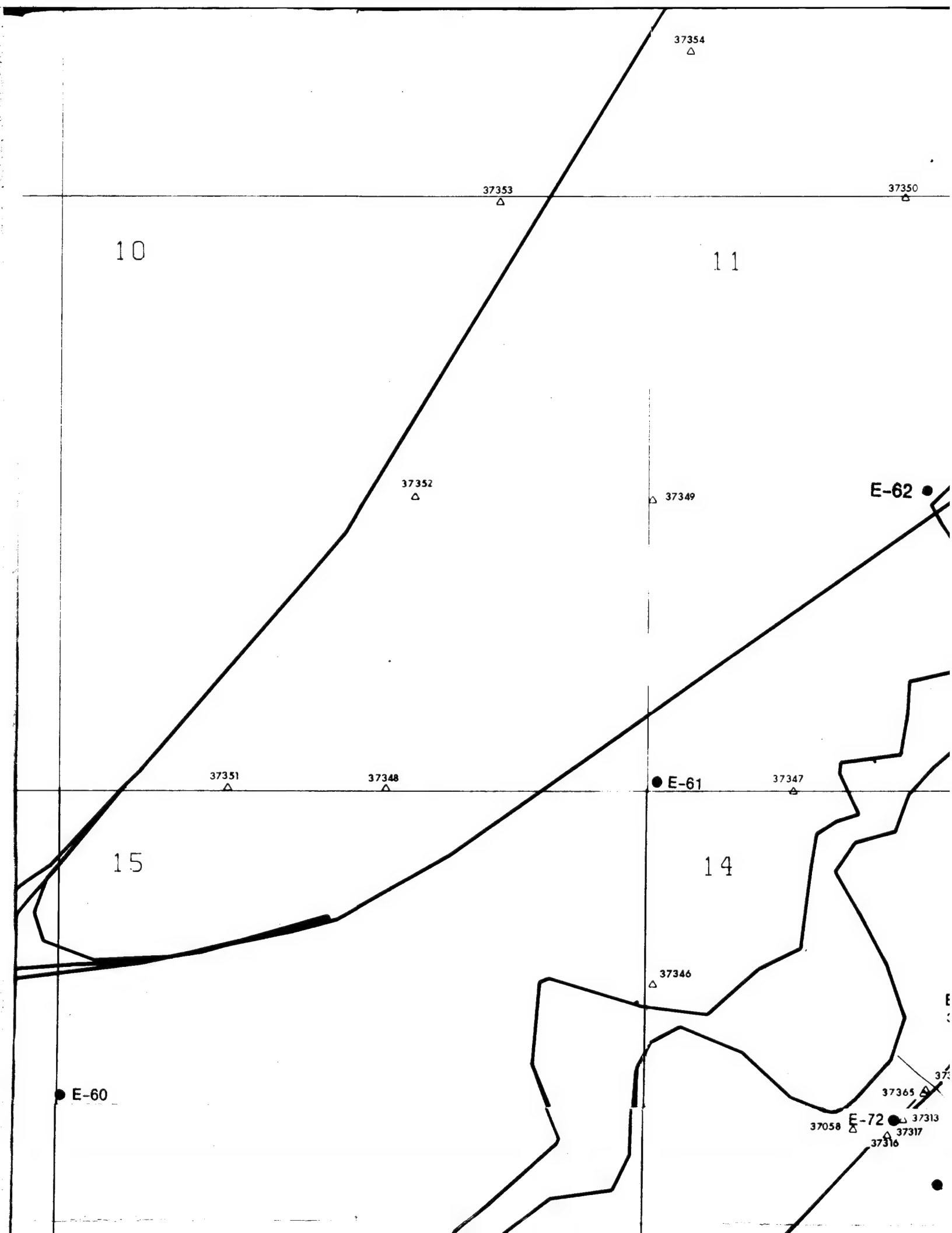
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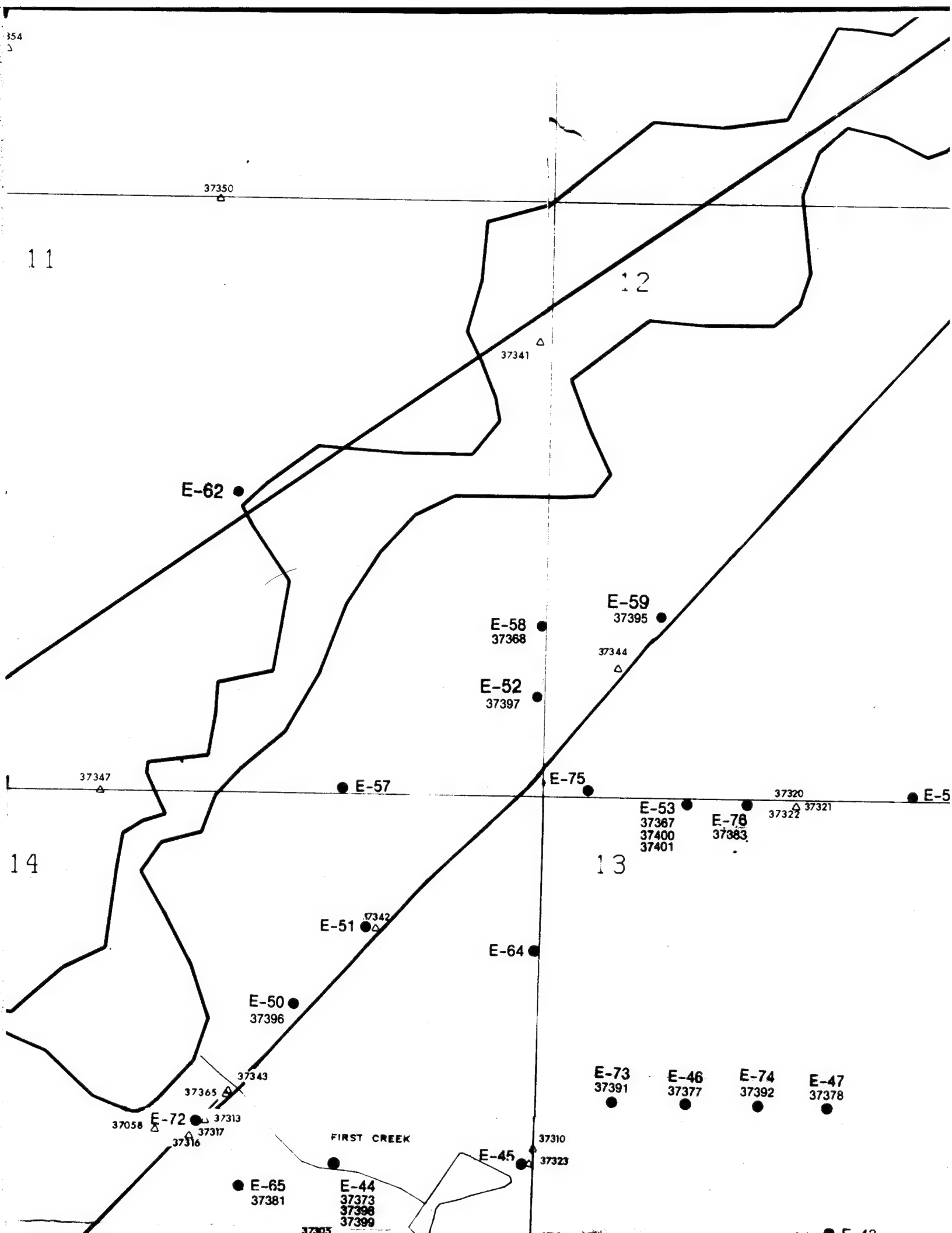
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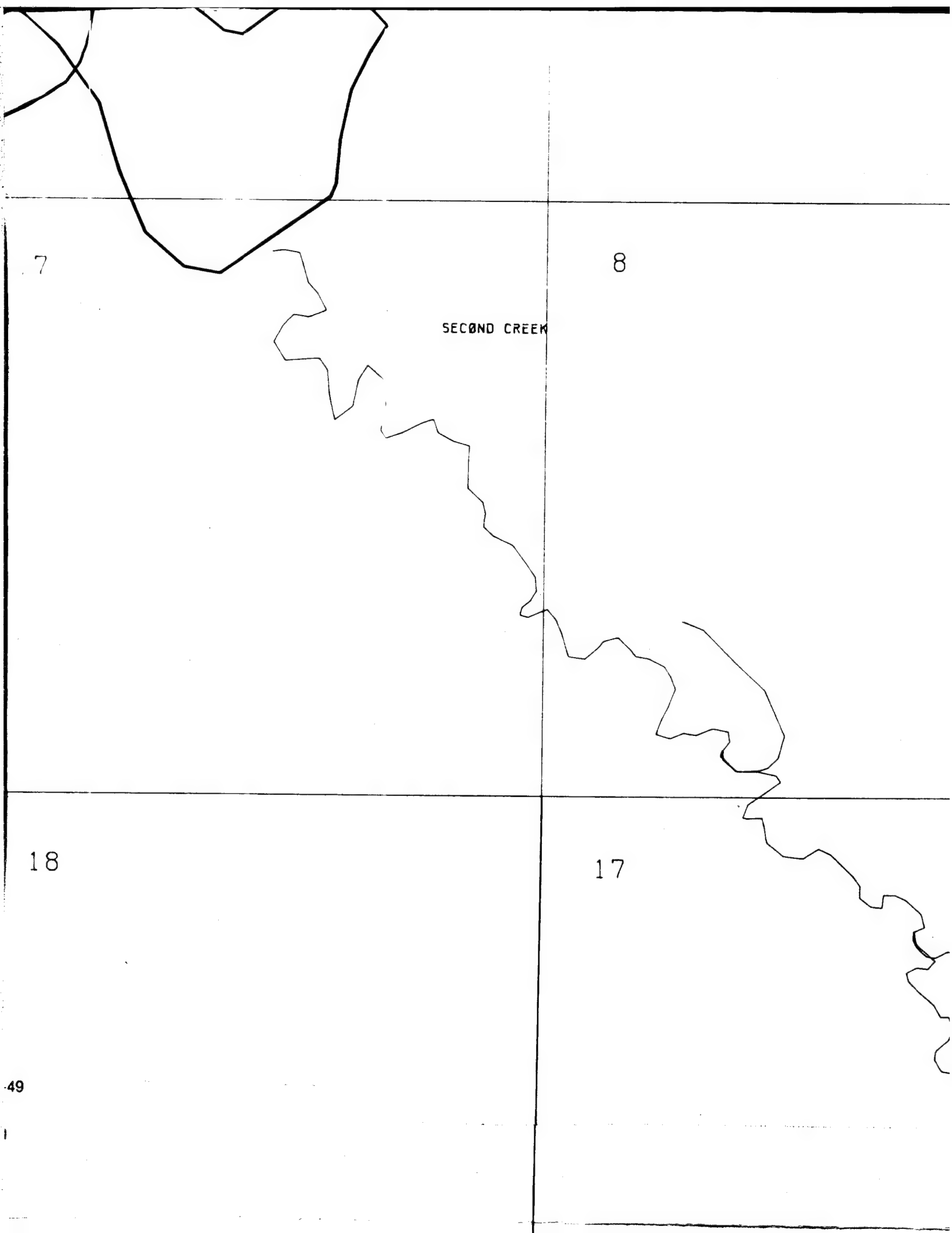
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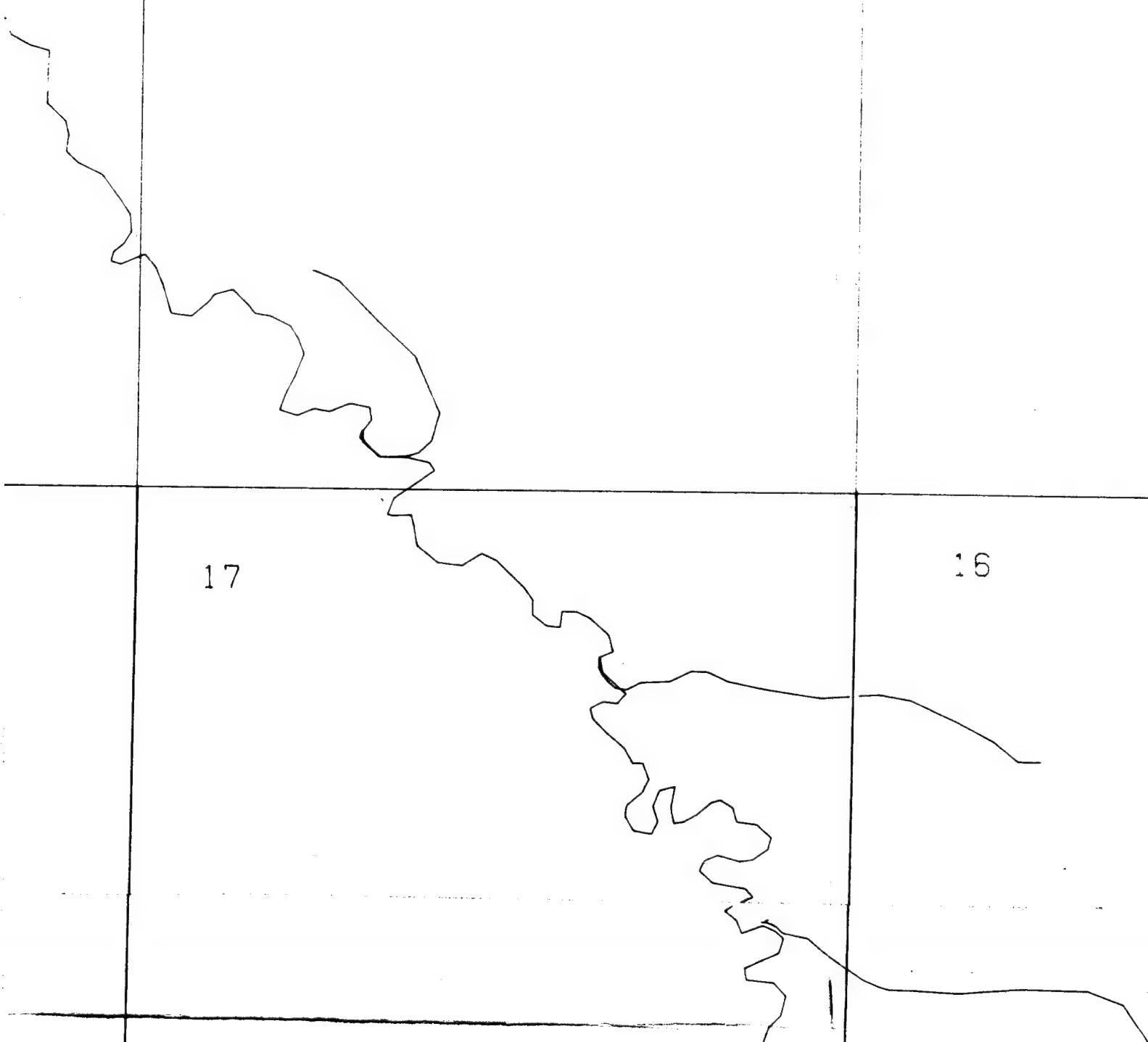
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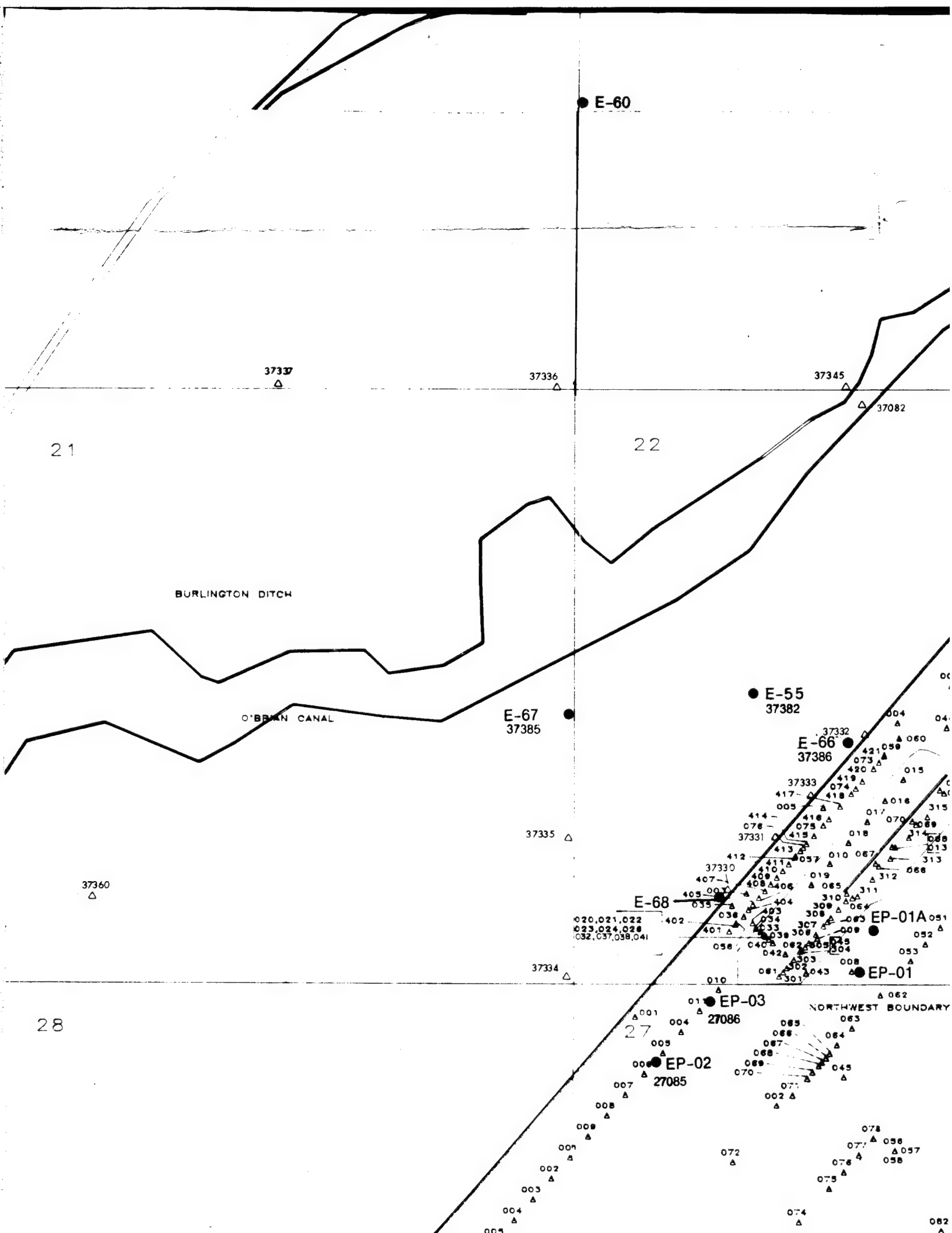
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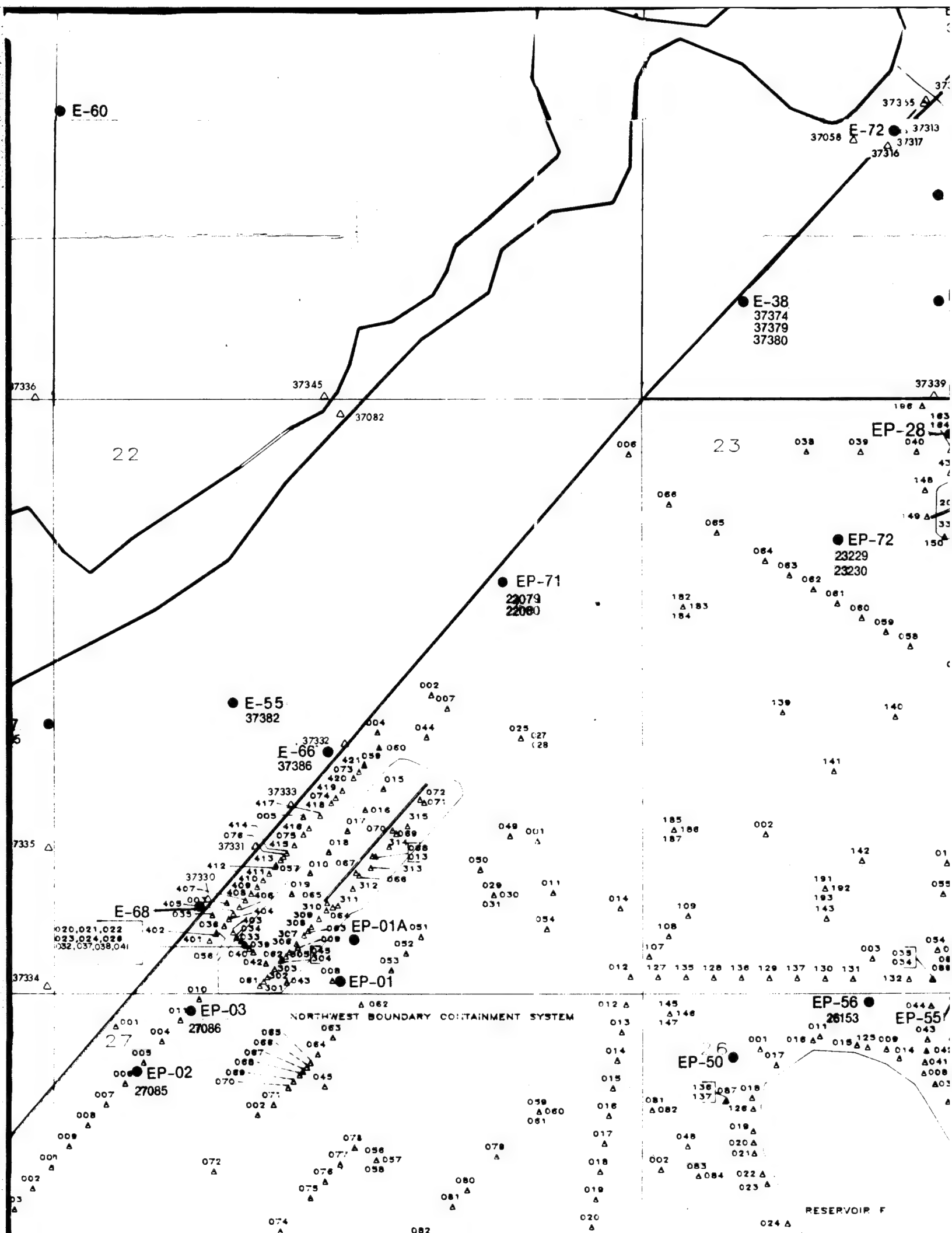
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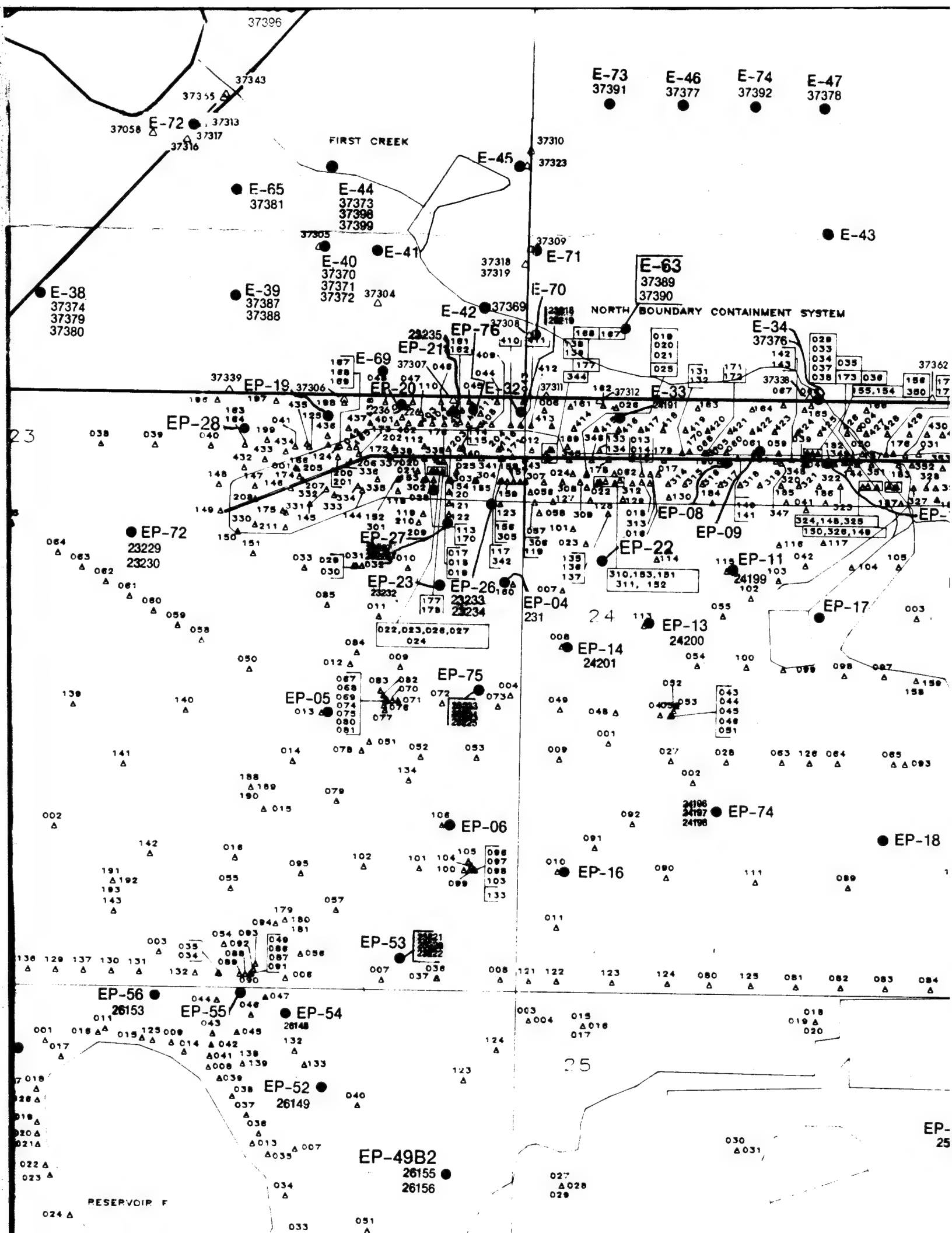
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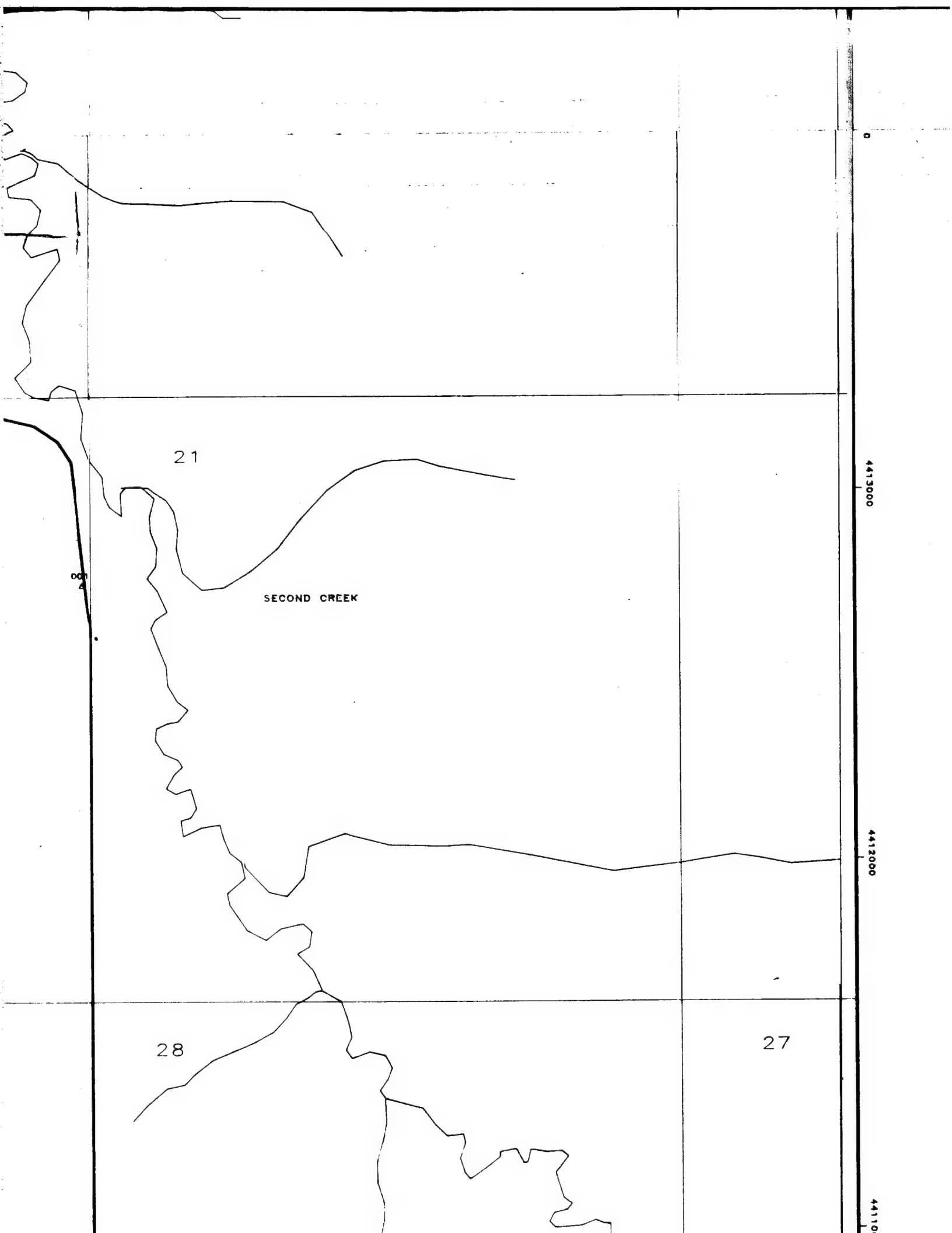
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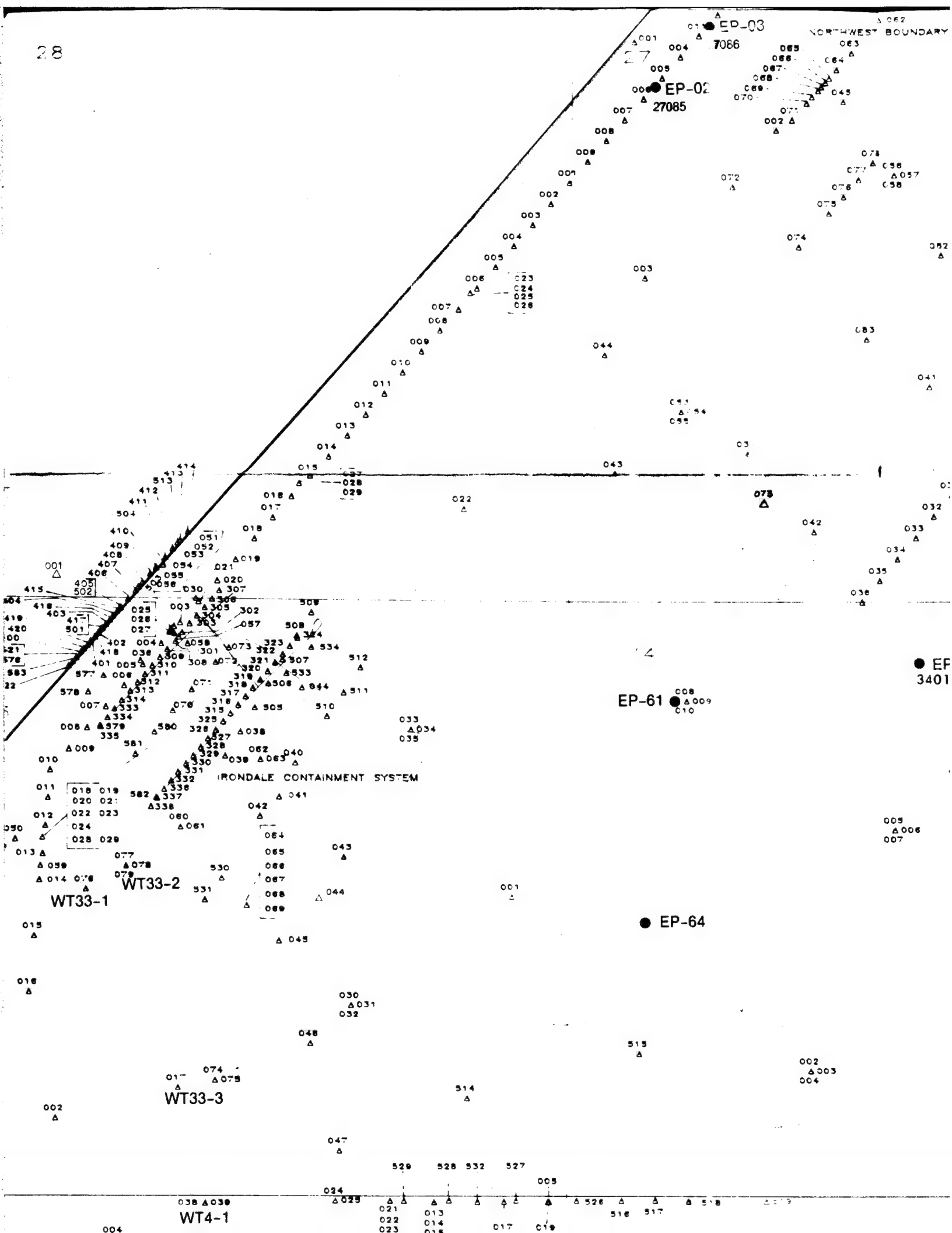
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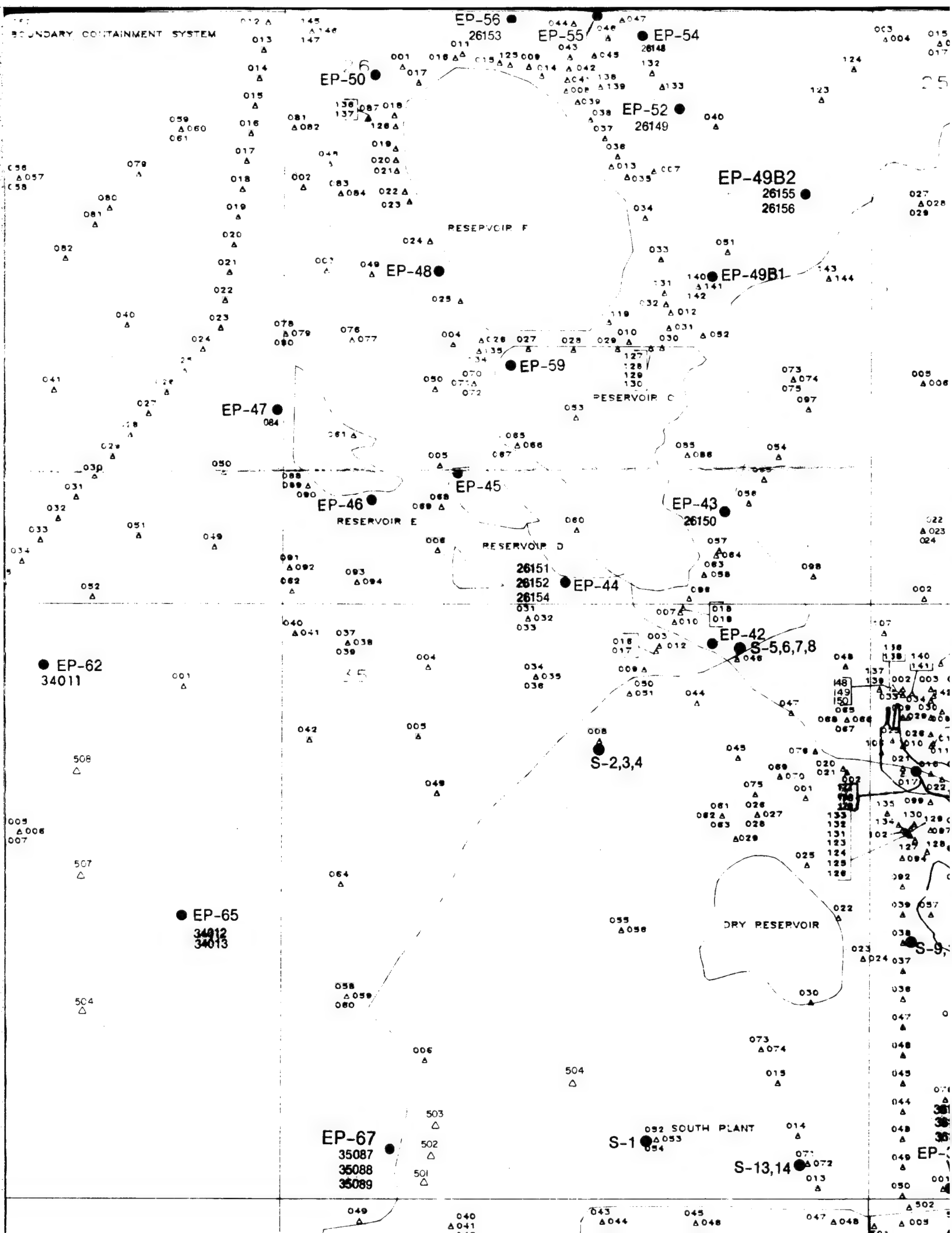
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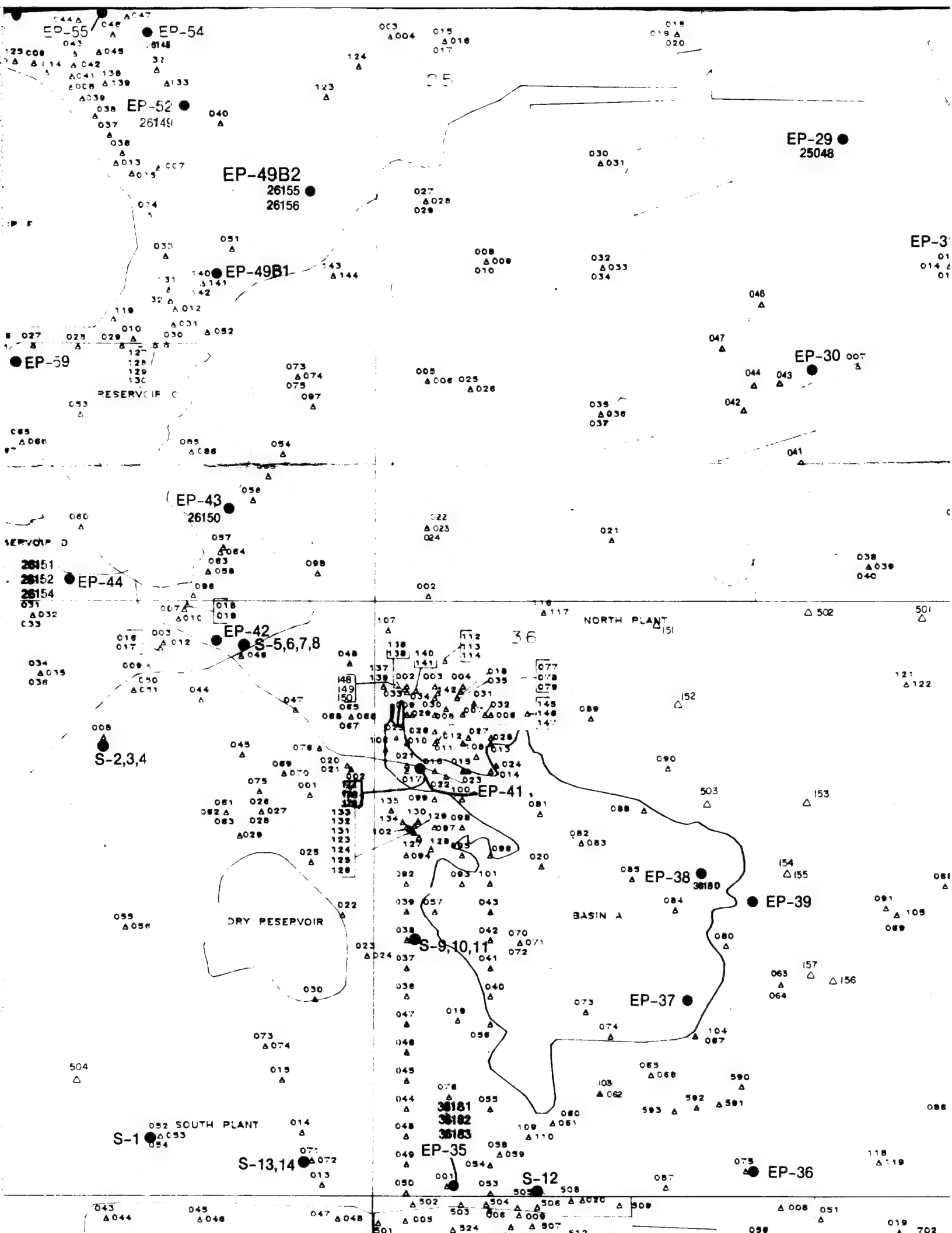
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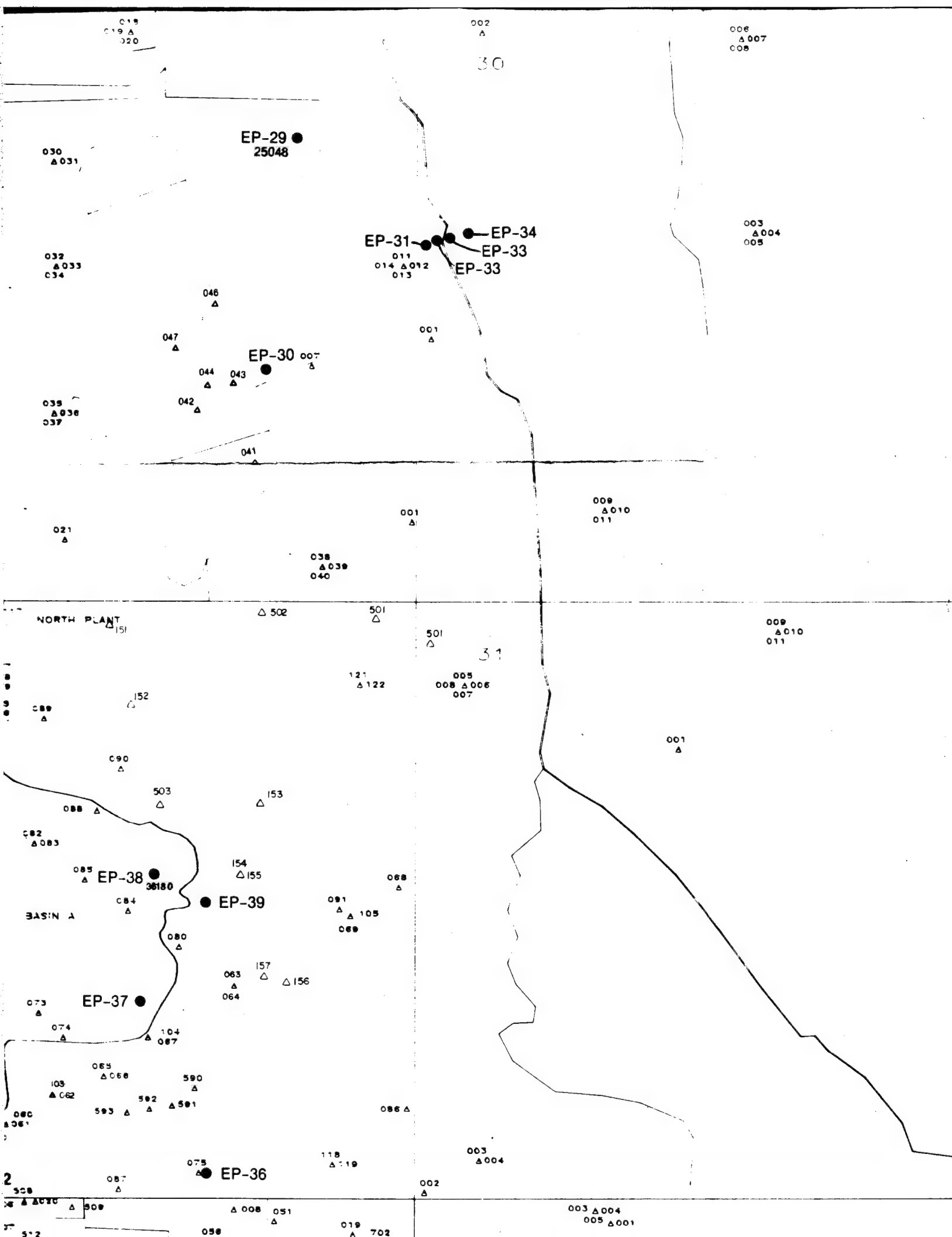
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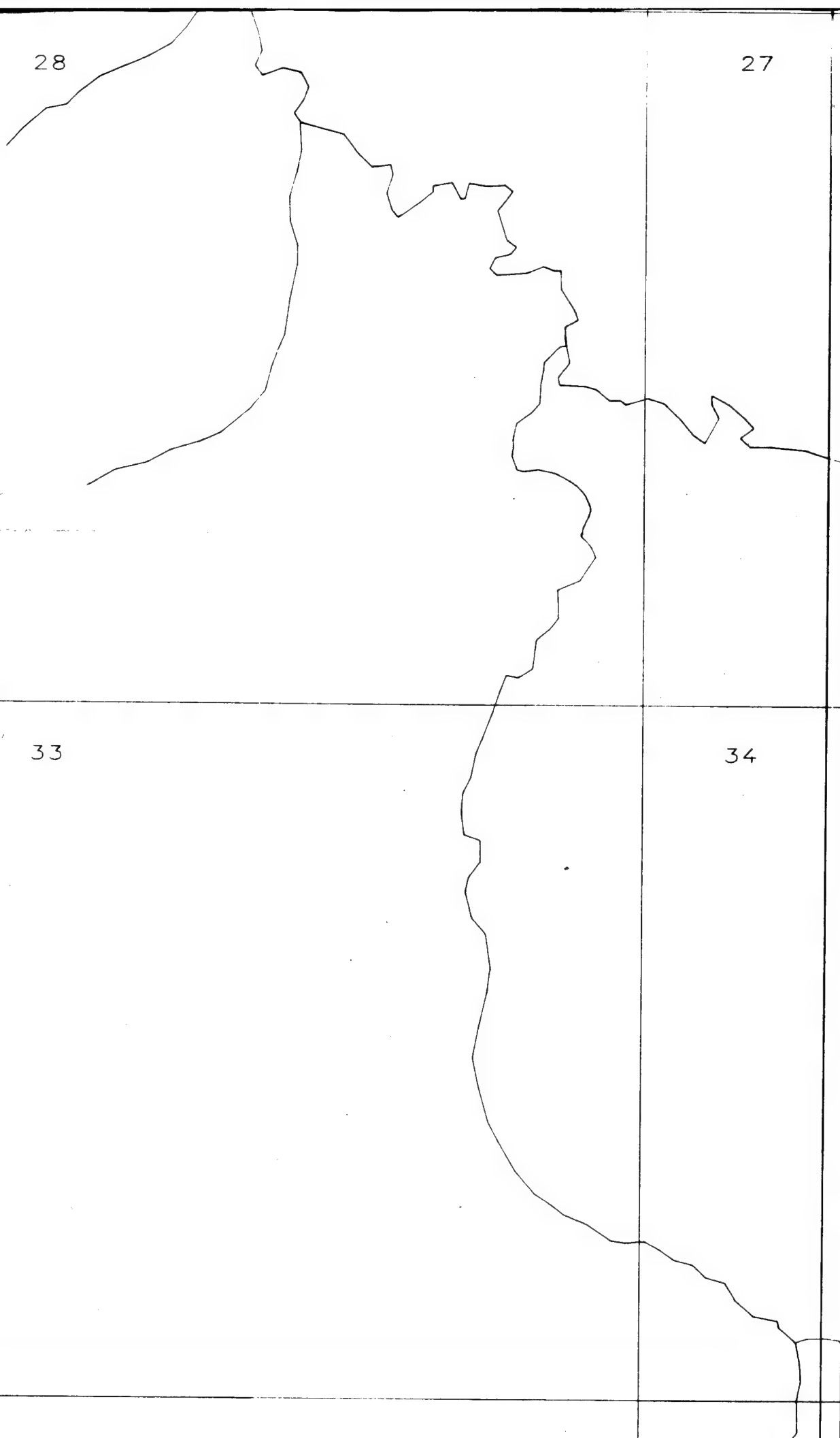
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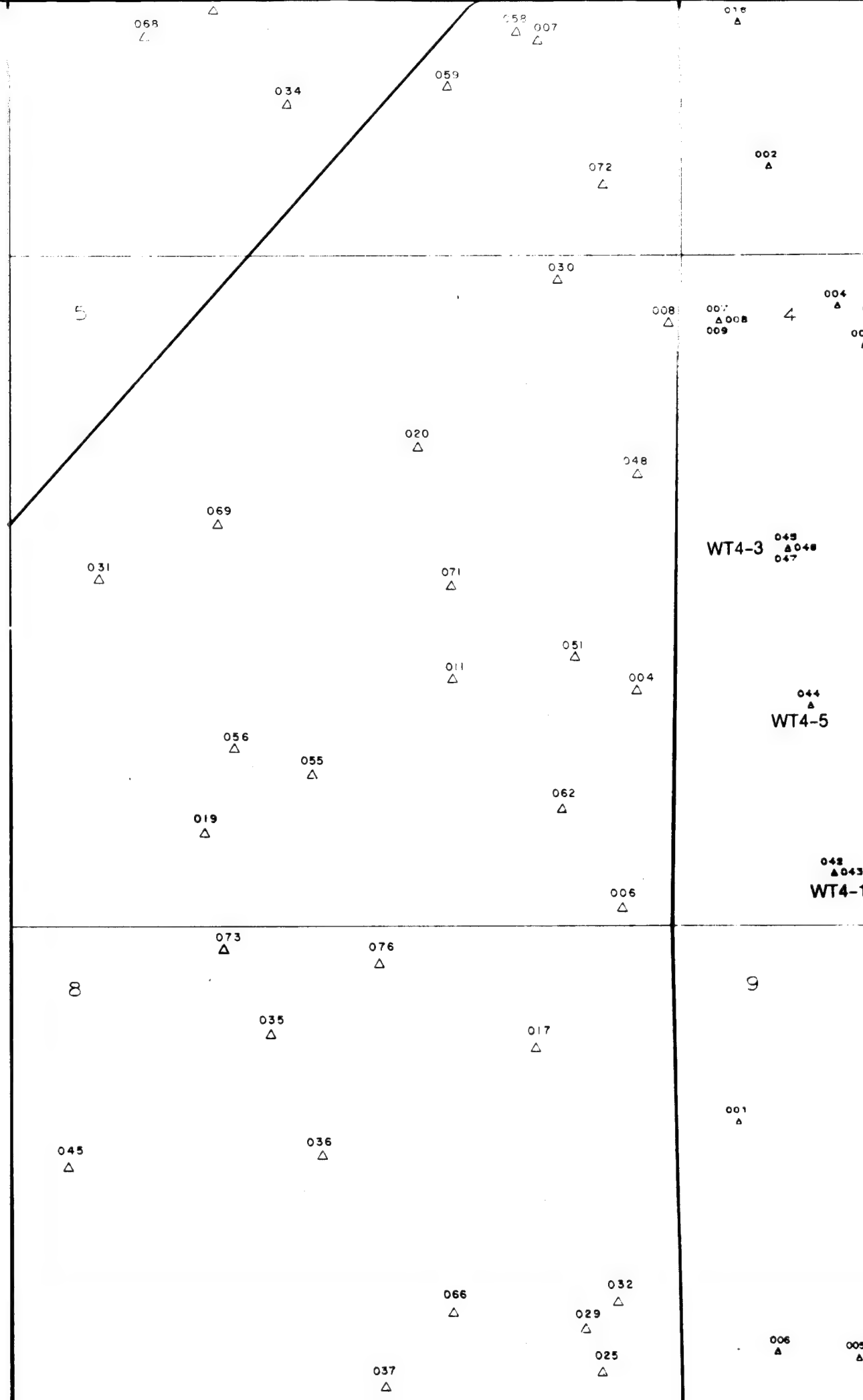
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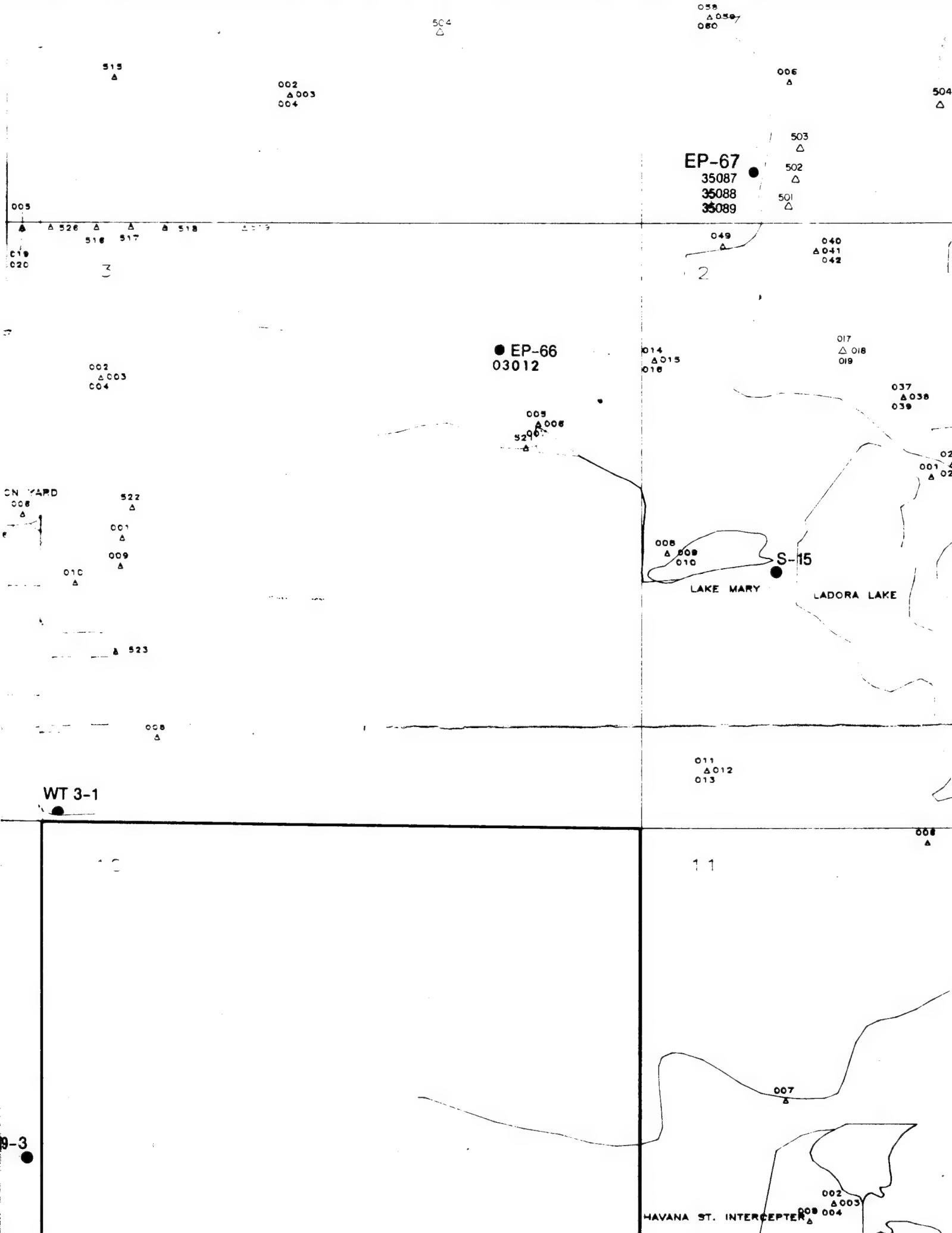
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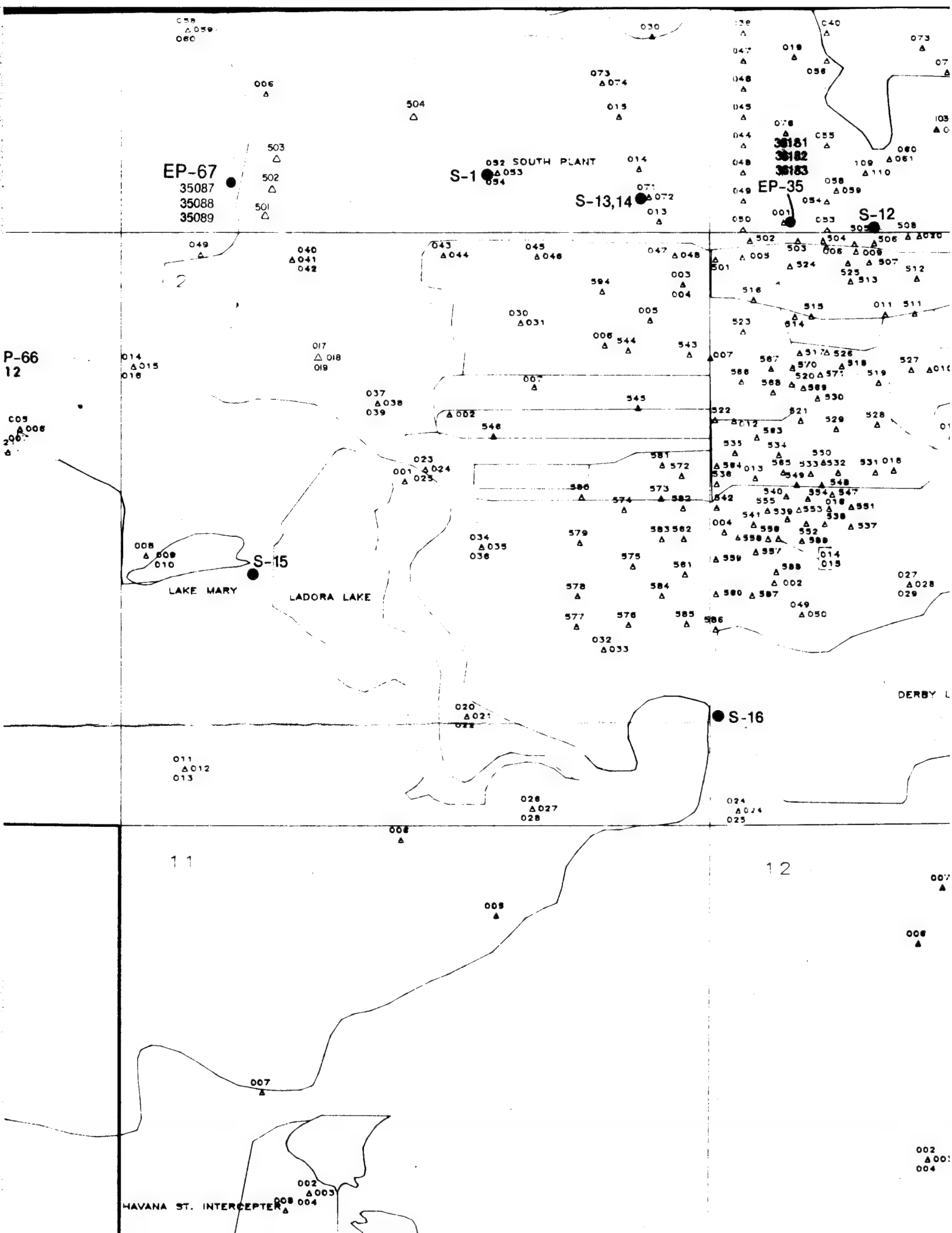
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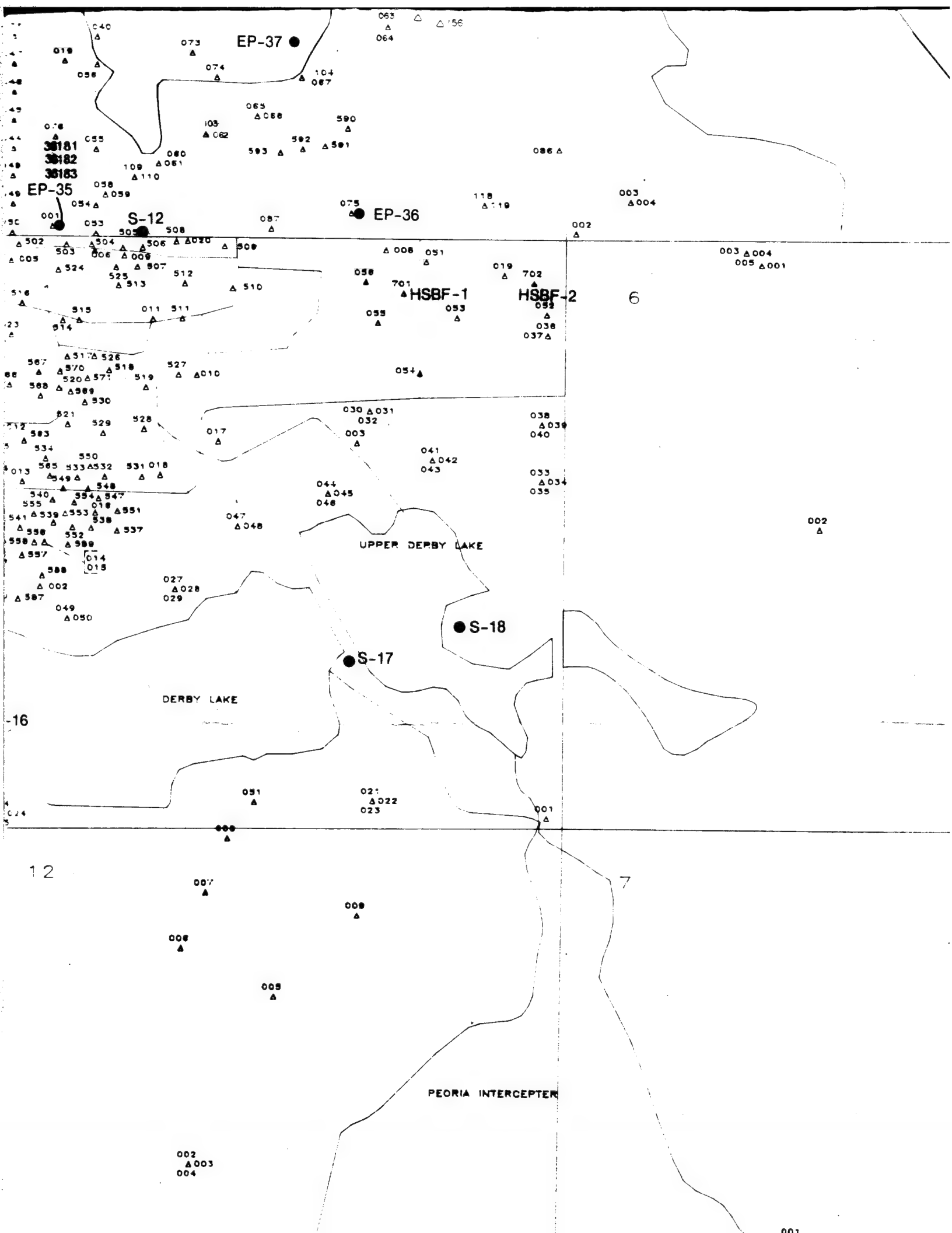
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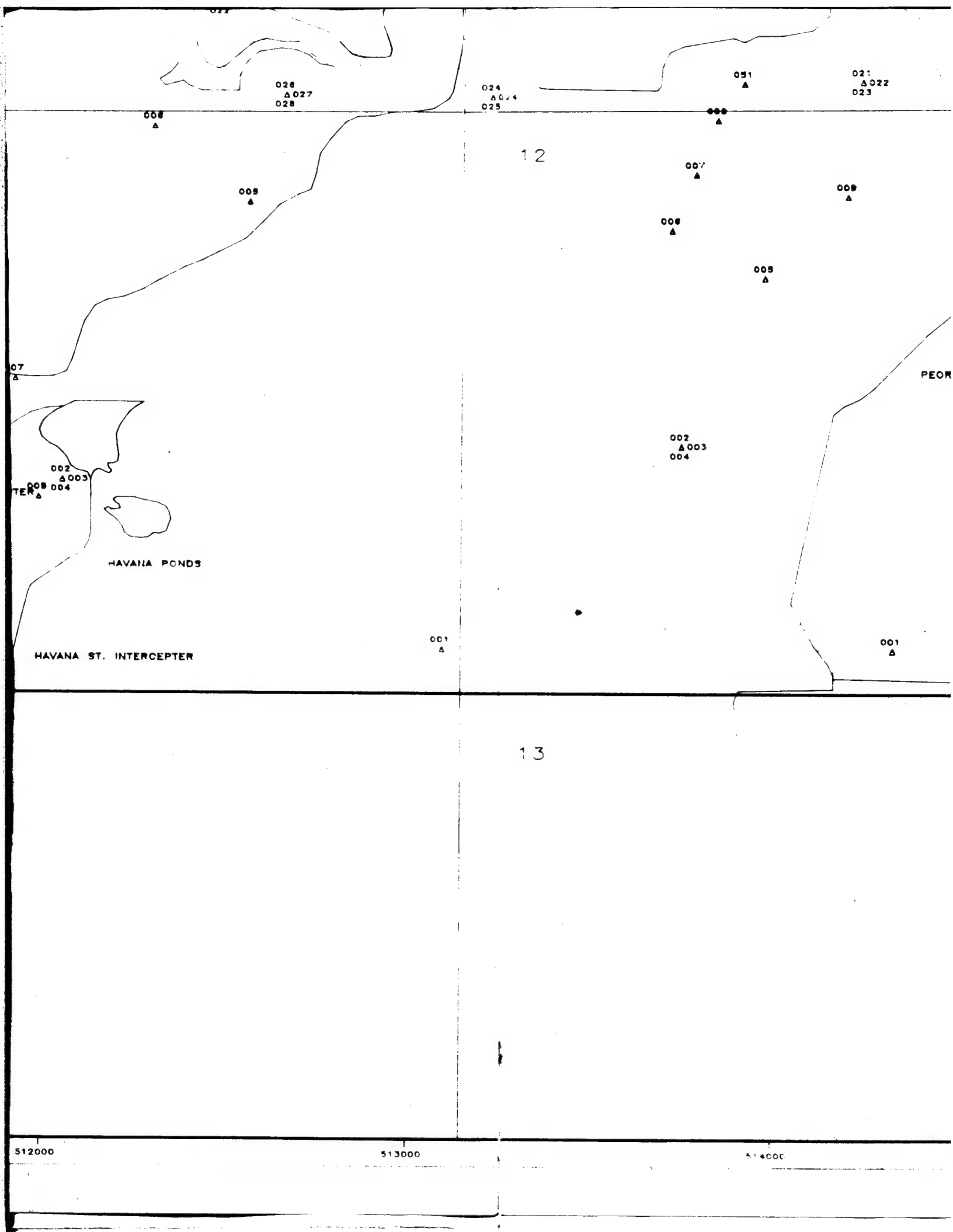
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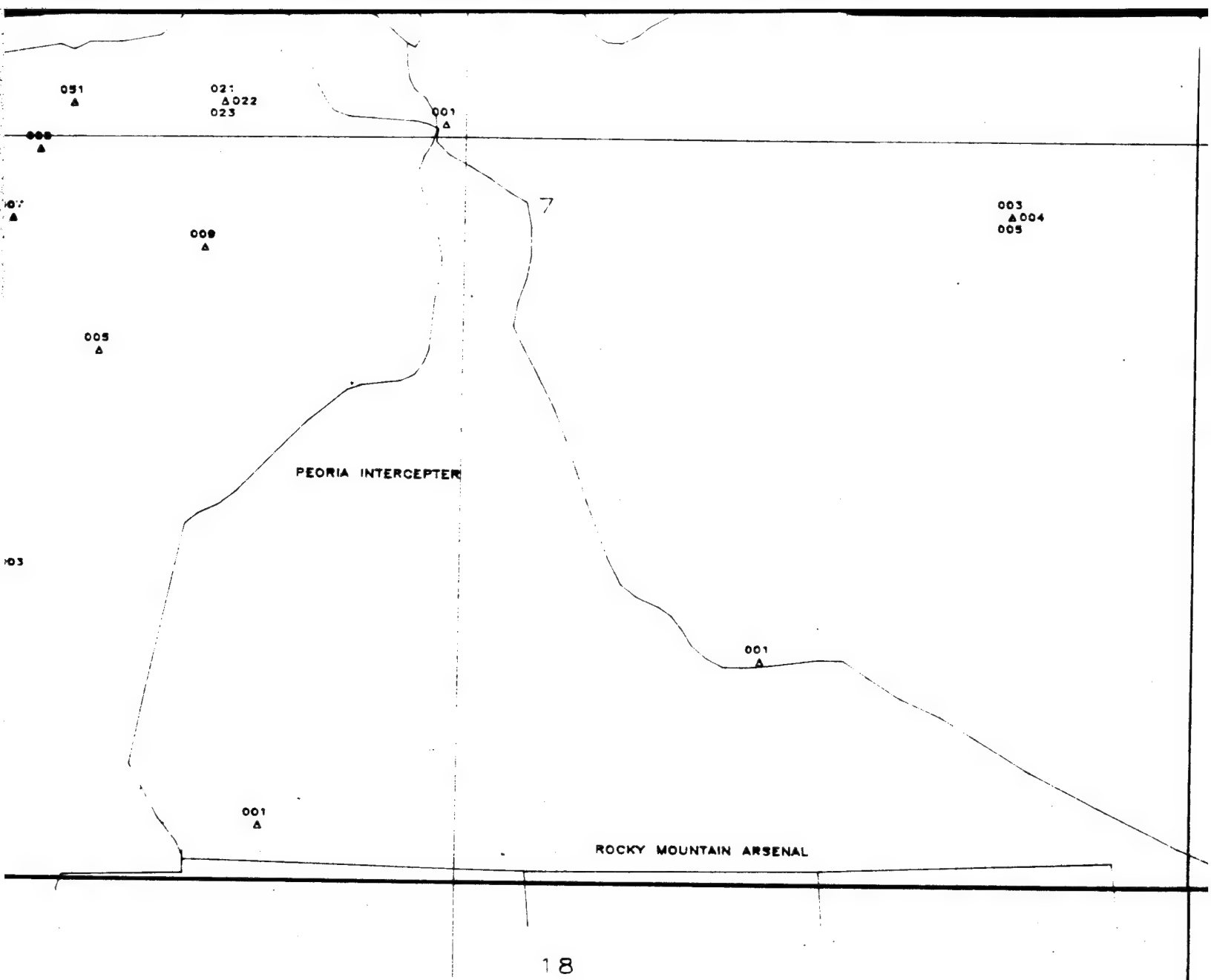
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### EXPLANATION

- EP-41 ESE Onpost Proposed Location
- E-42 ESE Offpost Proposed Location
- S-2 EBASCO Proposed Location (Task 26)
- WT4-12 EBASCO Proposed Location (Task 38)
- ▲ 101 Existing Well Location

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**Plate 1**    **COMPOSITE W**  
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③	W.B.	Updated
②	J.L.	P.G.
①	Updated	1/13/88
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① Revised

DRAWN/REVISED    BY    CHK'D

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FILE LOCATION : T4B-4

**Plate 1 COMPOSITE WELL PROGRAM PROPOSED LOCATION**

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④			
③	W.B.	Updated	7/88
②	JL	P.G.	
①	Updated	1/13/88	
		3/87	1-87
① Revised			
			9-86
DRAWN/REVISED	BY	CHK'D	DATE

Prepared for:  
U.S. Army Program Manager's Office  
For Rocky Mountain Arsenal  
Aberdeen Proving Ground, Maryland

**ESE ENVIRONMENTAL SCIENCE  
AND ENGINEERING, INC.**

AN RSC COMPANY

D. Stephens  
APPROVED FOR ISSUE BY  
1-87  
DATE

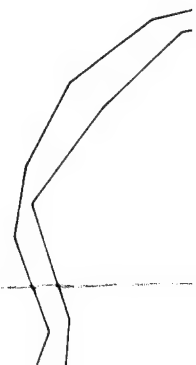


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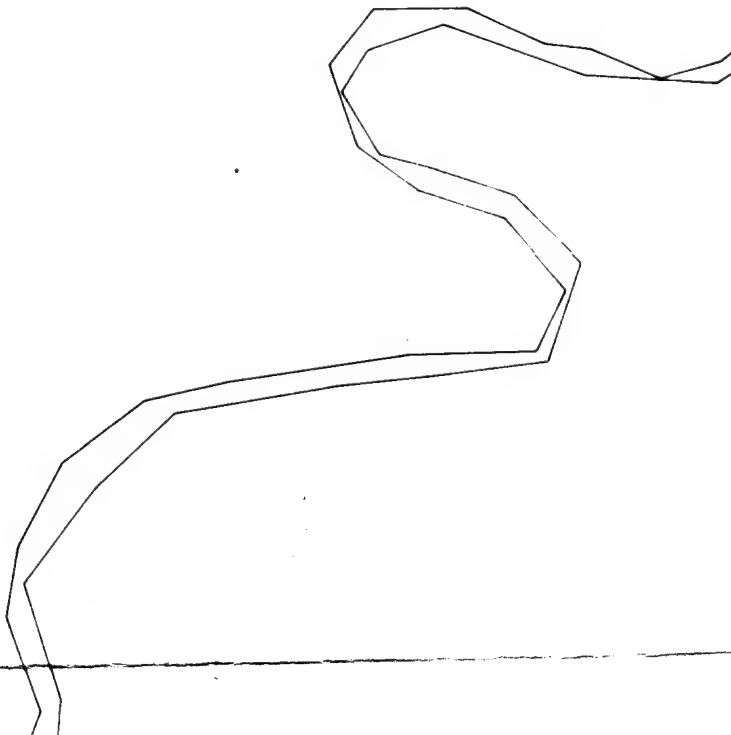
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A line drawing of a wavy, irregular shape, possibly a stylized letter 'S' or a decorative element, rendered in black ink on a white background. The shape is composed of two parallel, slightly offset lines that follow a similar path, creating a sense of depth or a double-line effect. The path starts at the bottom left, moves upwards and to the right, then curves sharply to the left, and finally curves back to the right towards the top right corner. The lines are hand-drawn and show some variation in thickness and slight irregularities.

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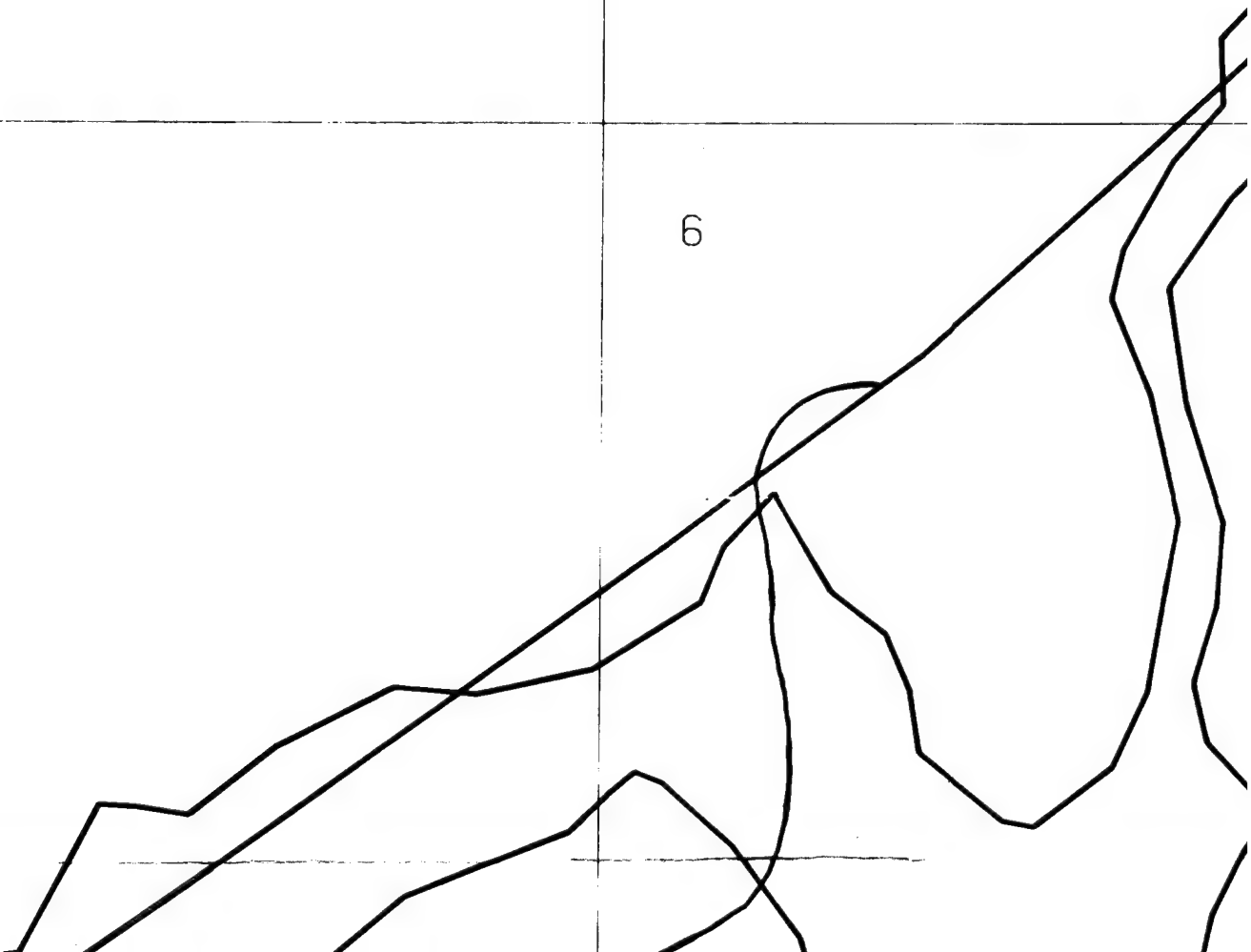
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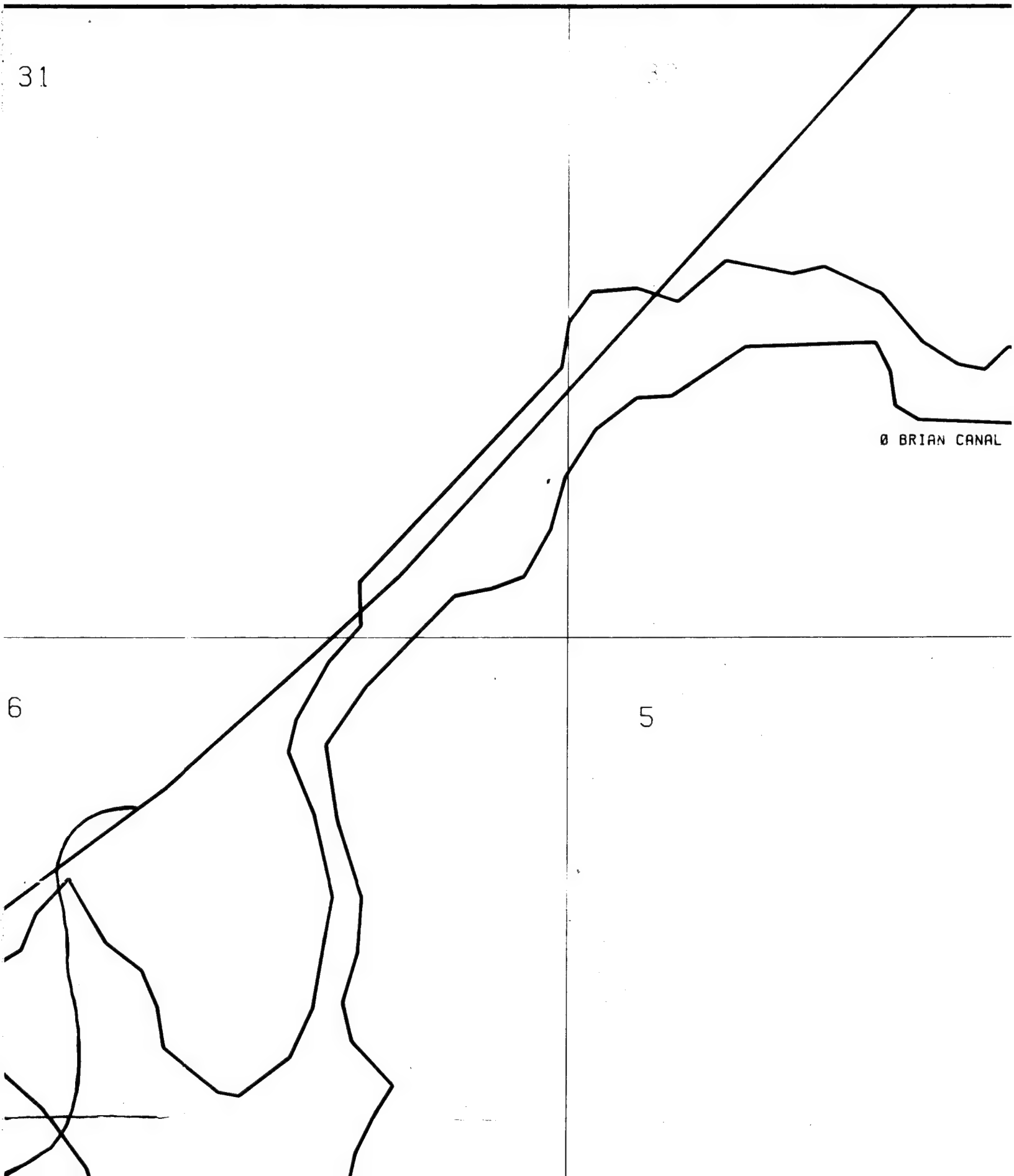
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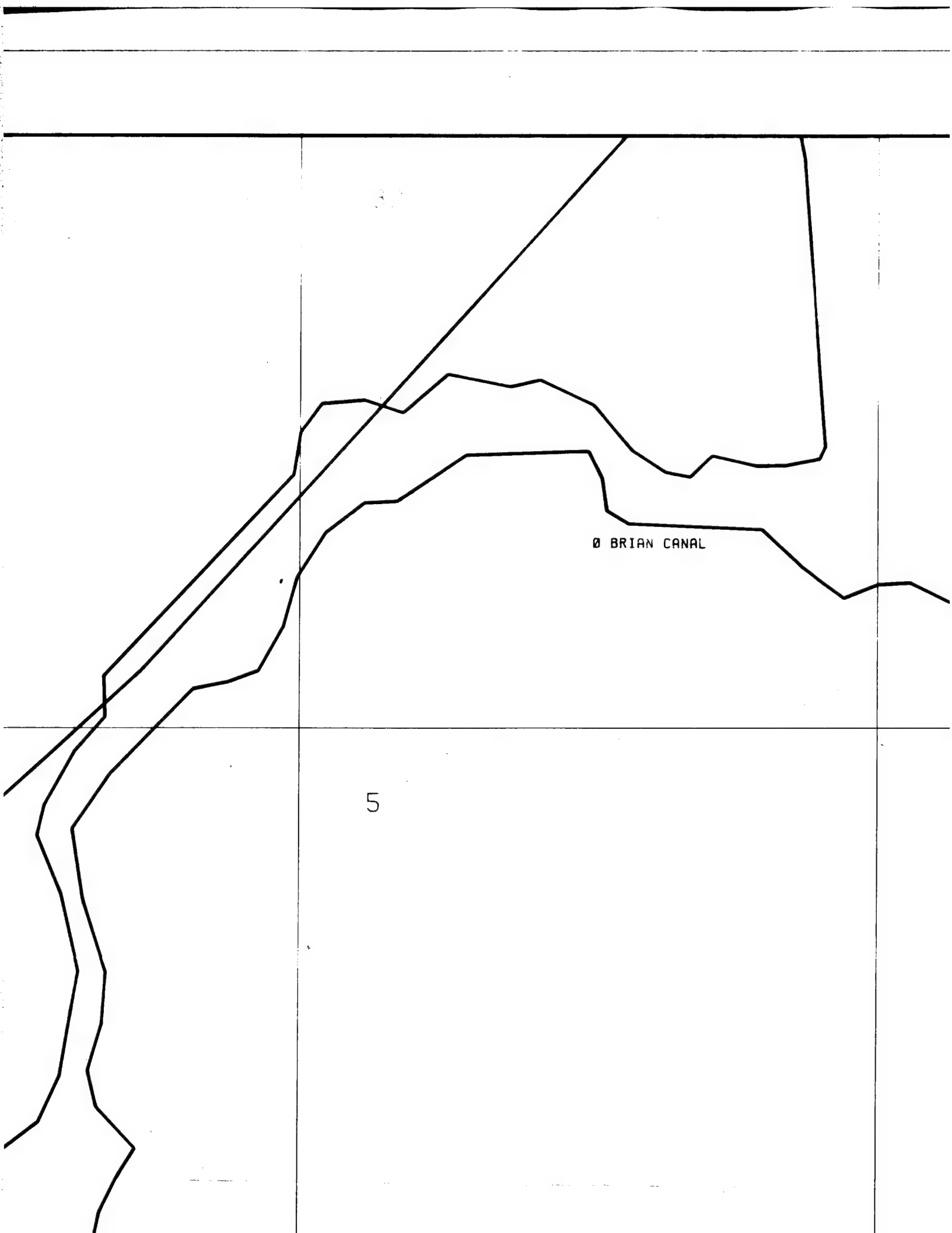
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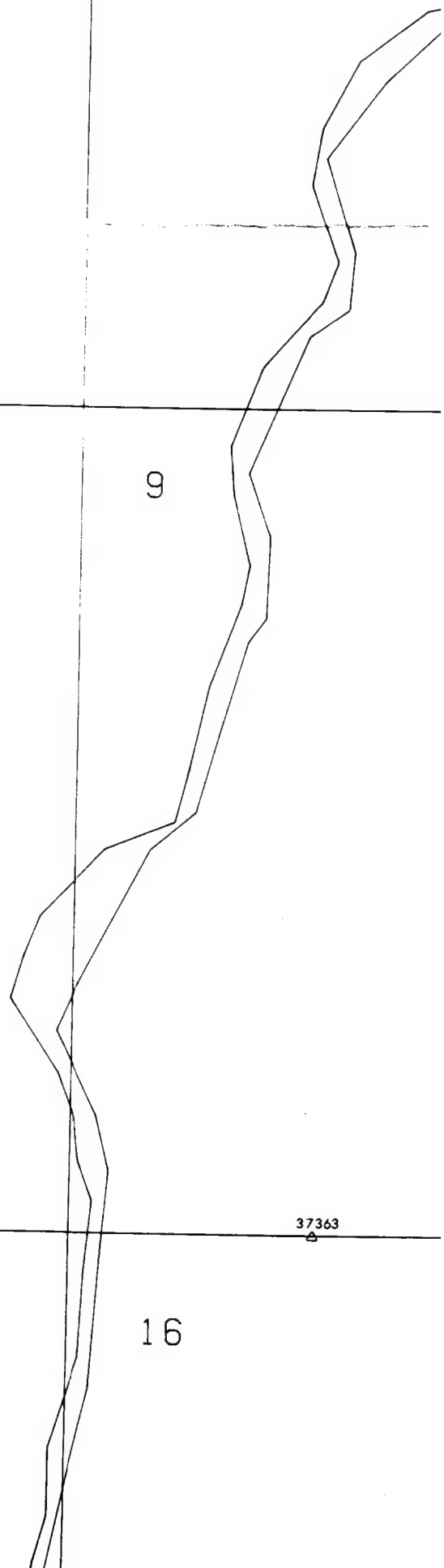
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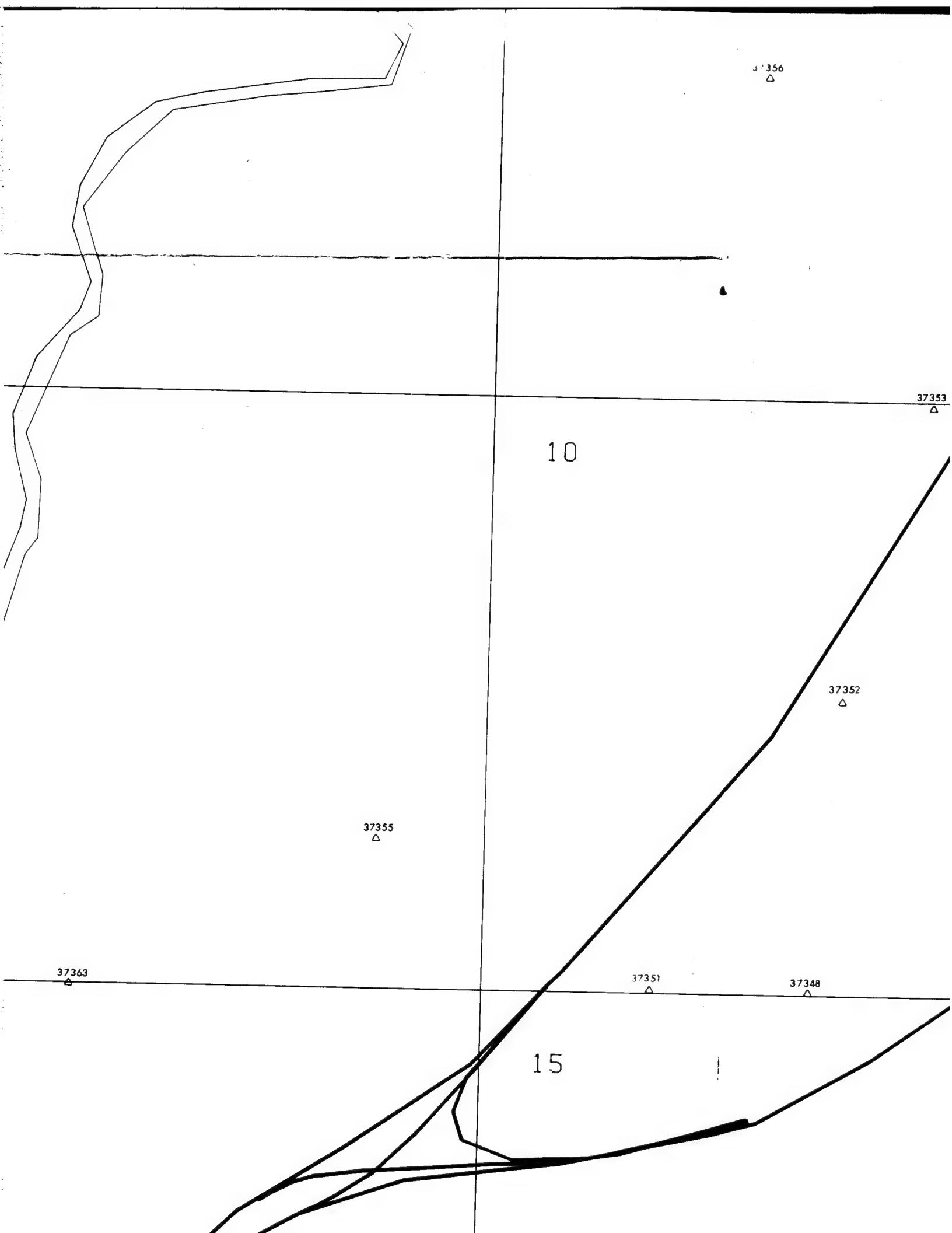
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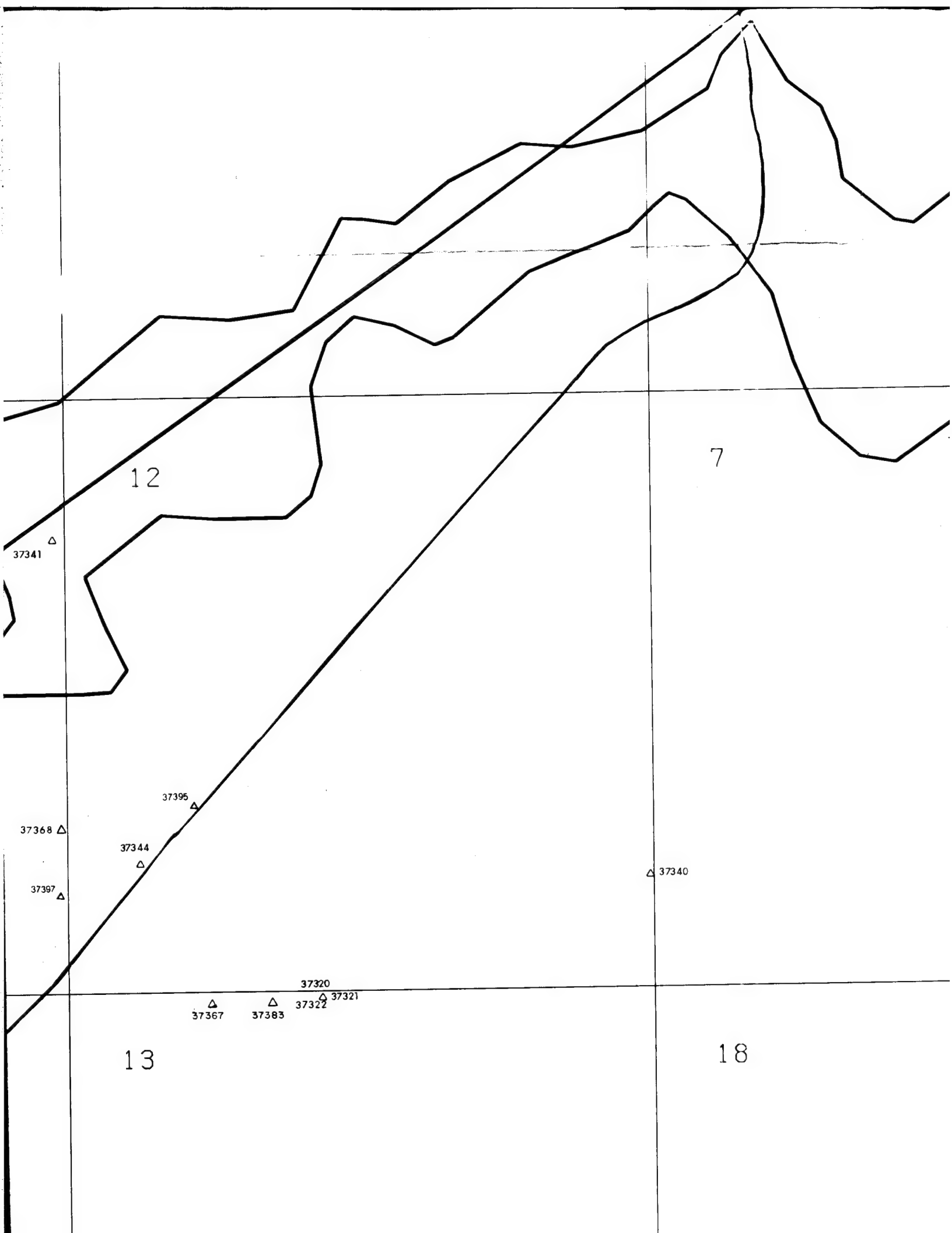
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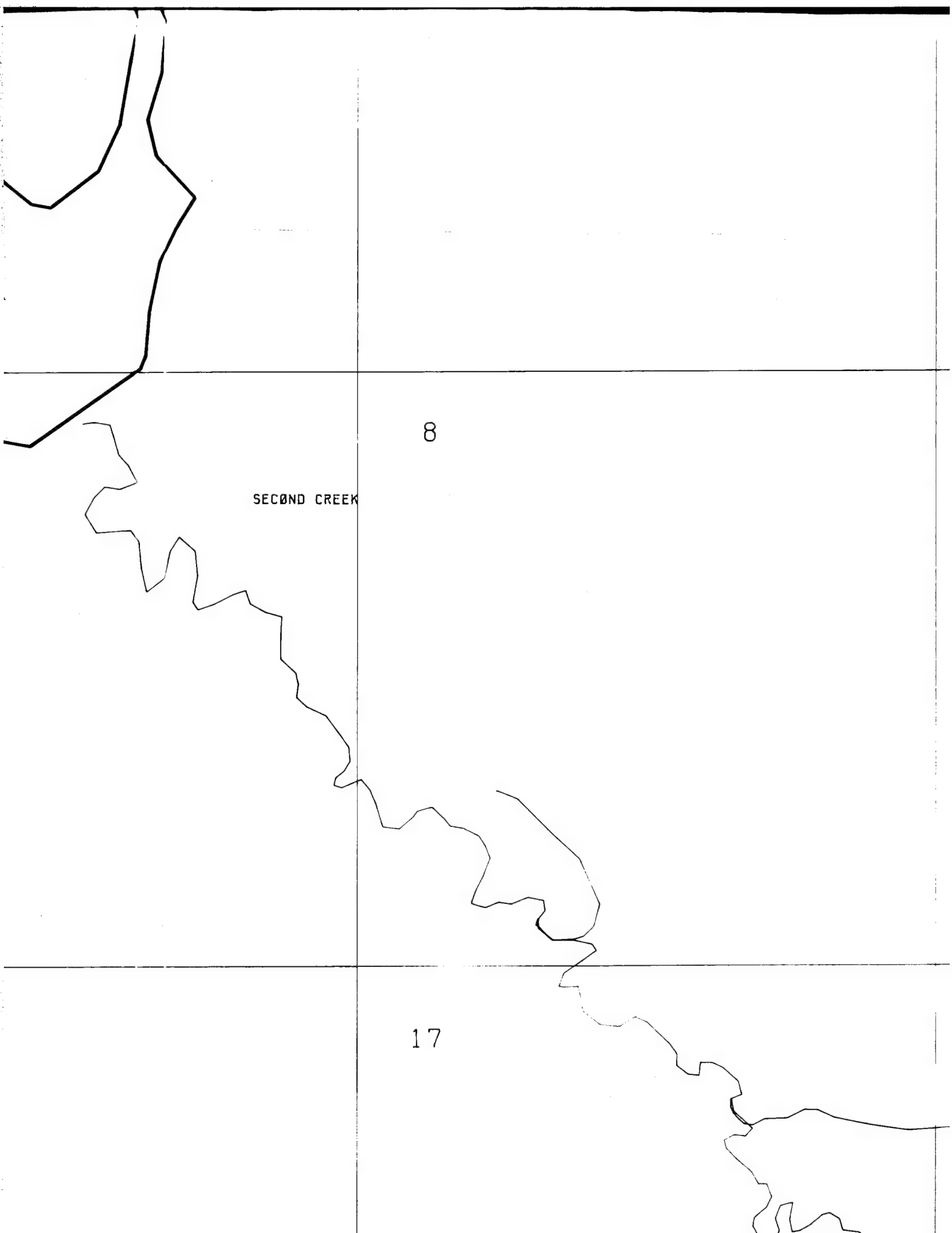
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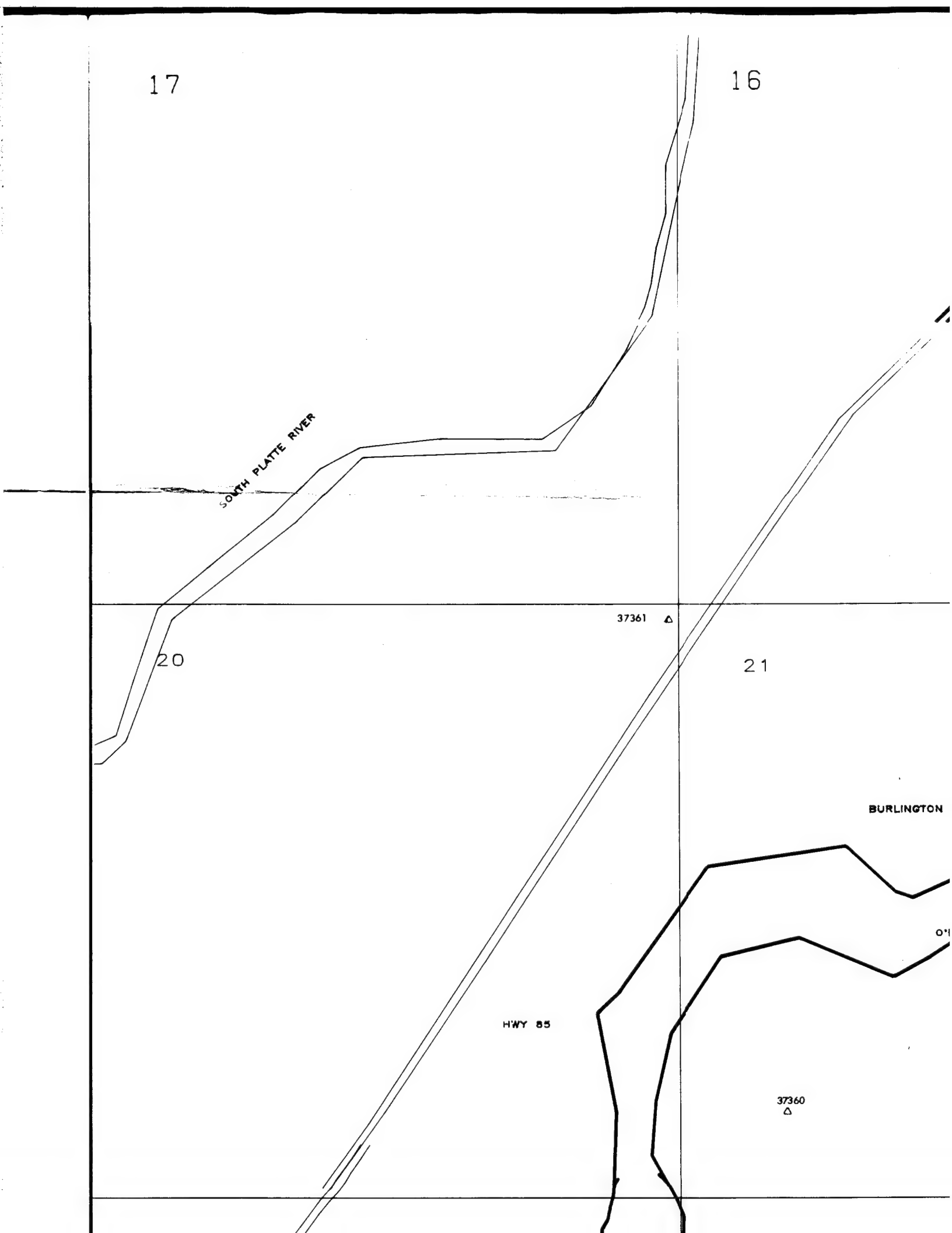
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37011

37010

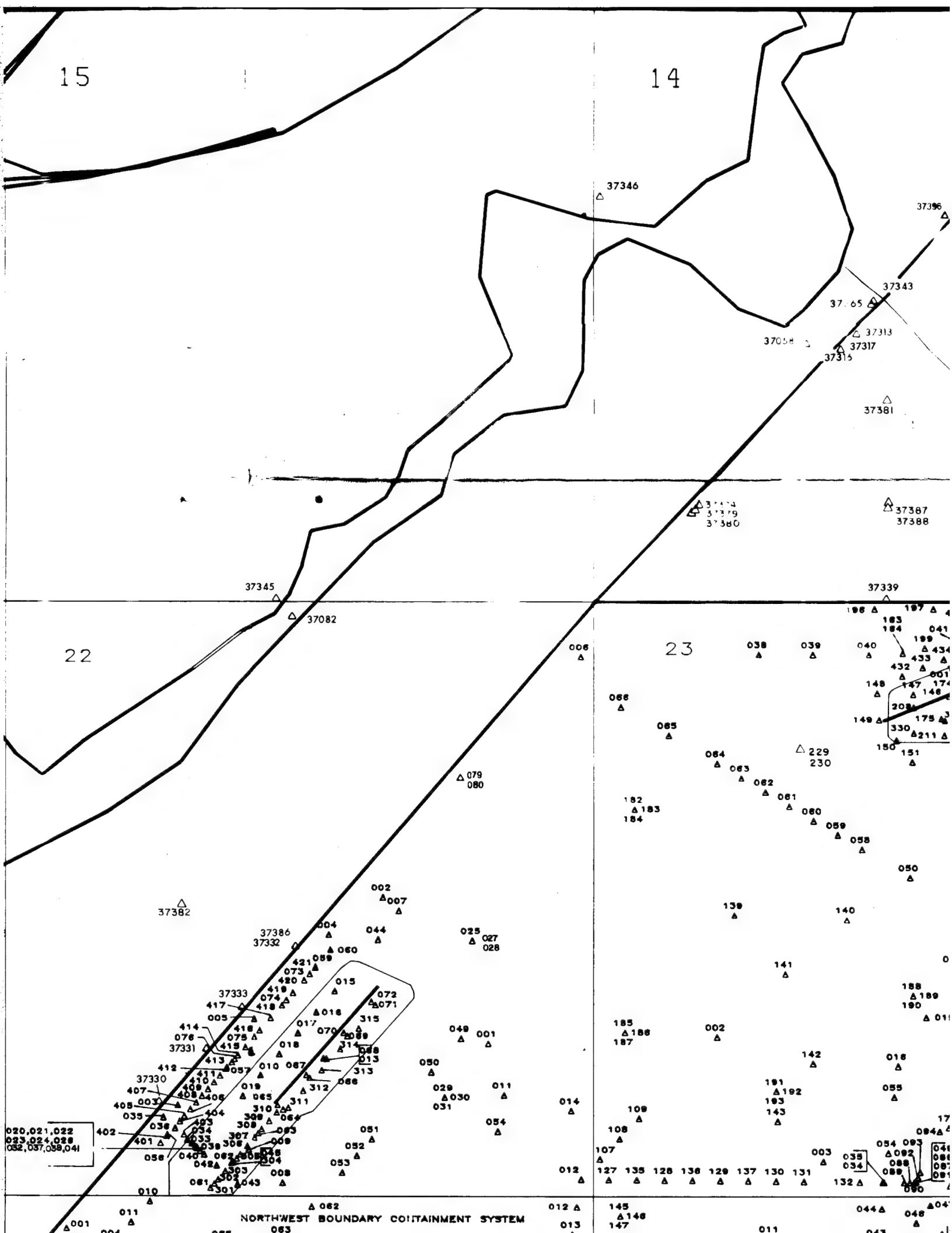
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37006

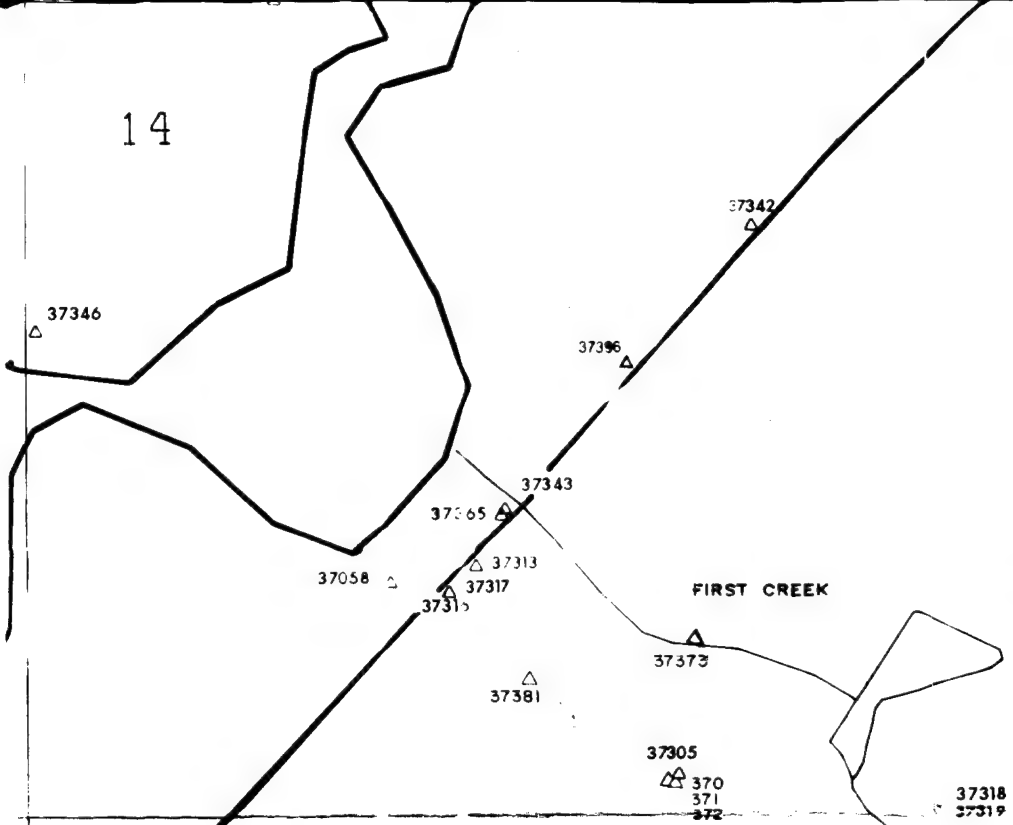




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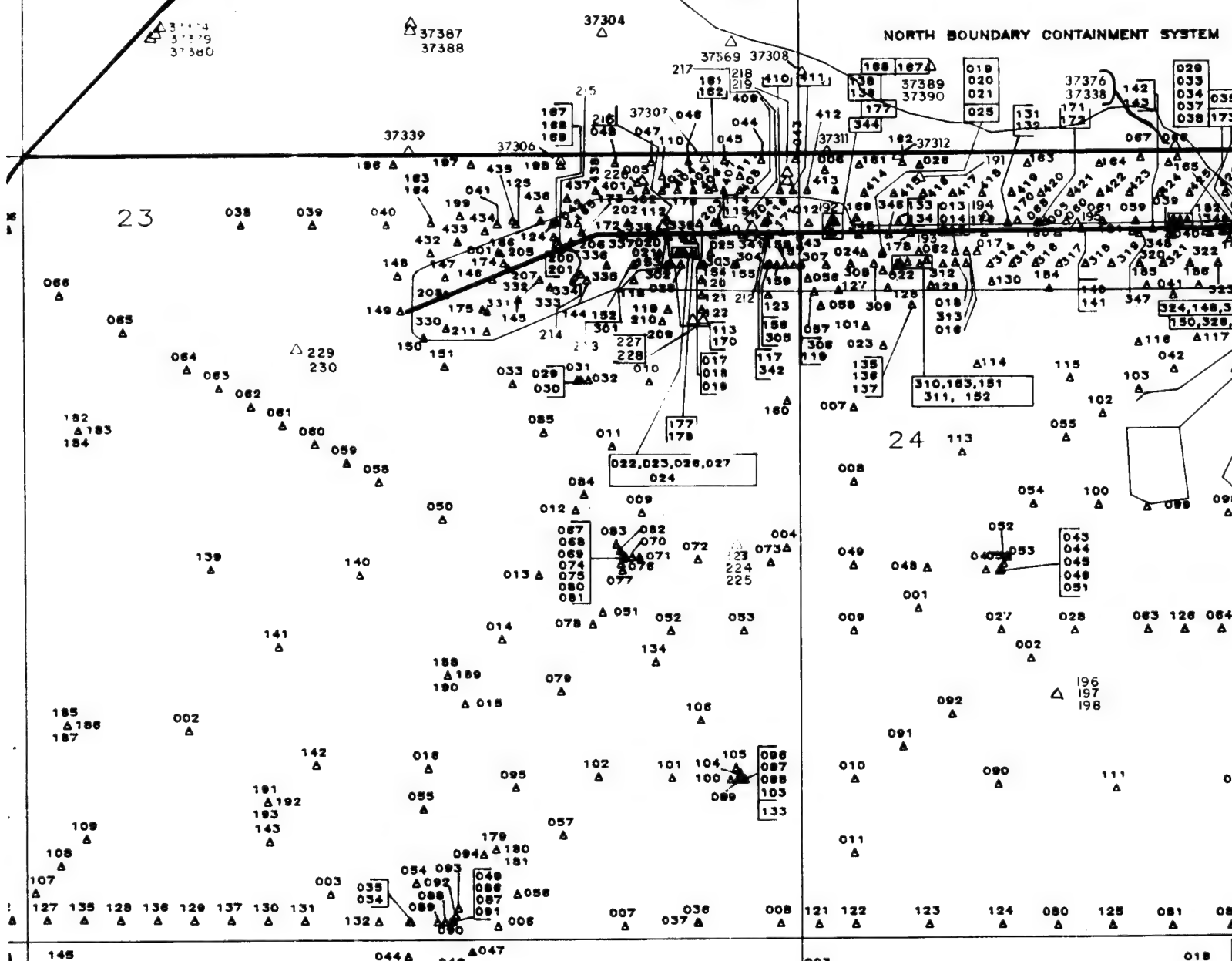
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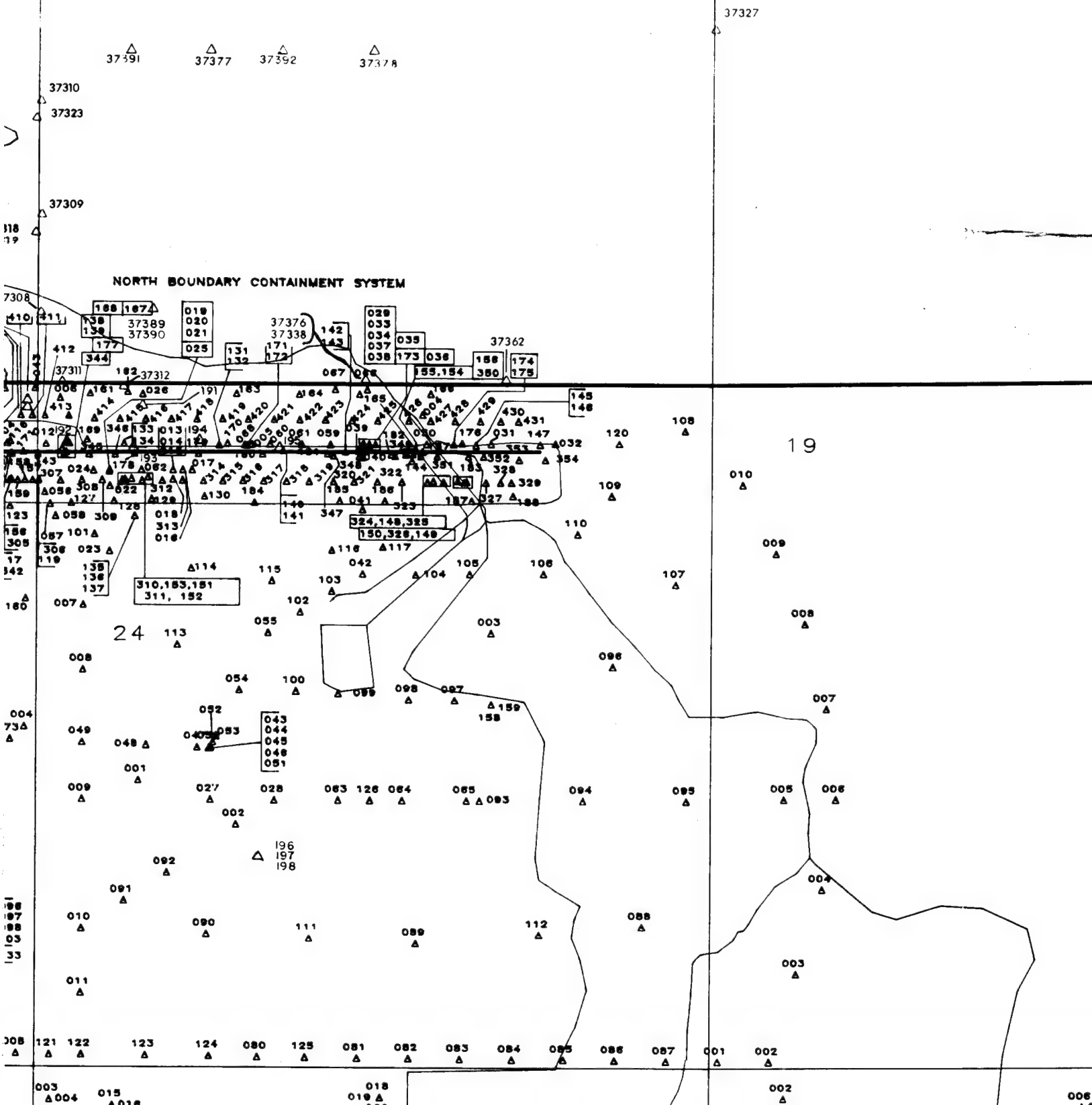
FIRST CREEK

NORTH BOUNDARY CONTAINMENT SYSTEM



13

18



18

17

014  
Δ015  
016

ROCKY MOUNTAIN ARSENAL

19

20

009  
Δ

008  
Δ

007  
Δ

017  
Δ018  
019

011  
Δ

005  
Δ

006  
Δ

004  
Δ

003  
Δ

002  
Δ

002  
Δ

008  
007

17

16

ROCKY MOUNTAIN ARSENAL

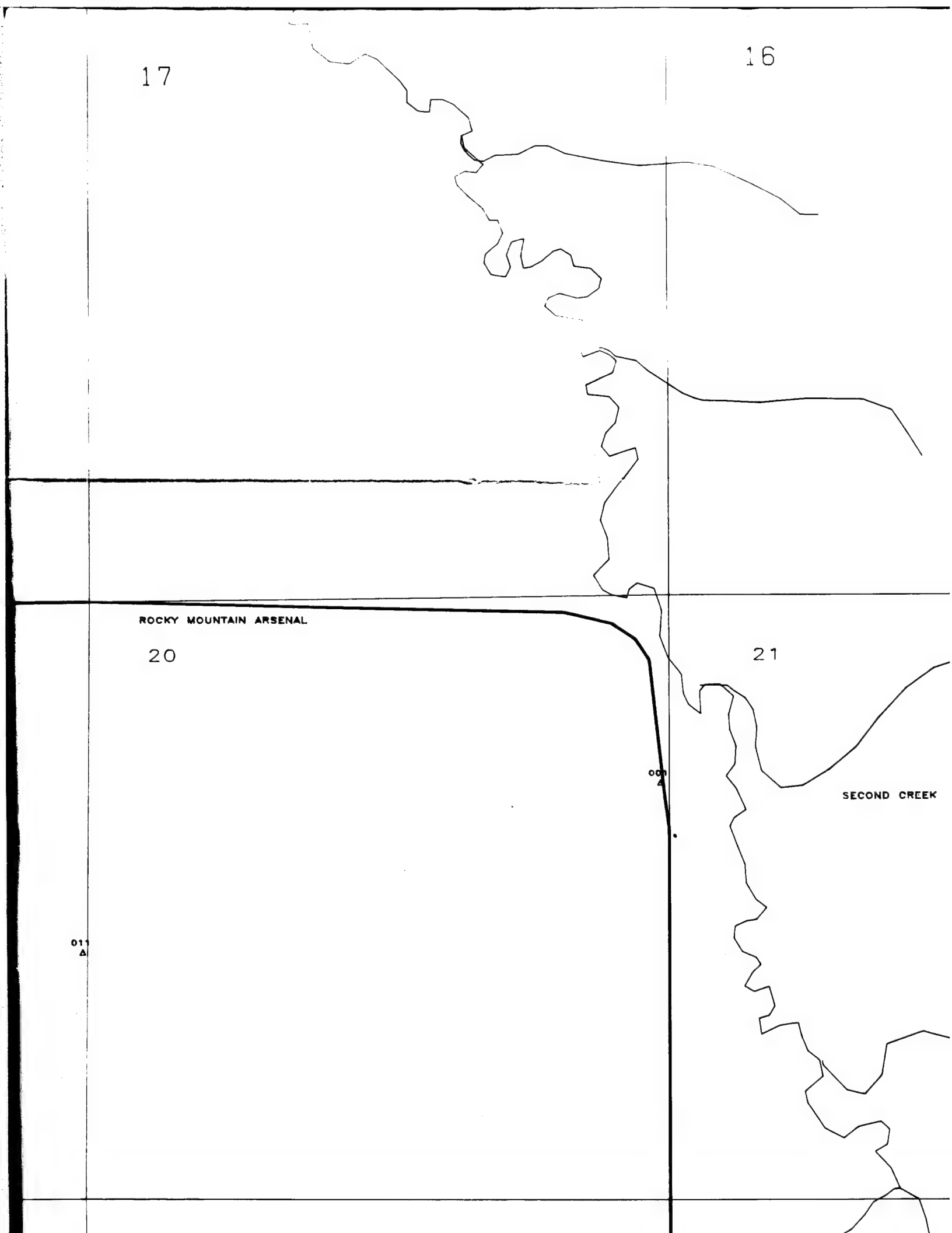
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21

SECOND CREEK

011  
Δ

000  
Δ



16

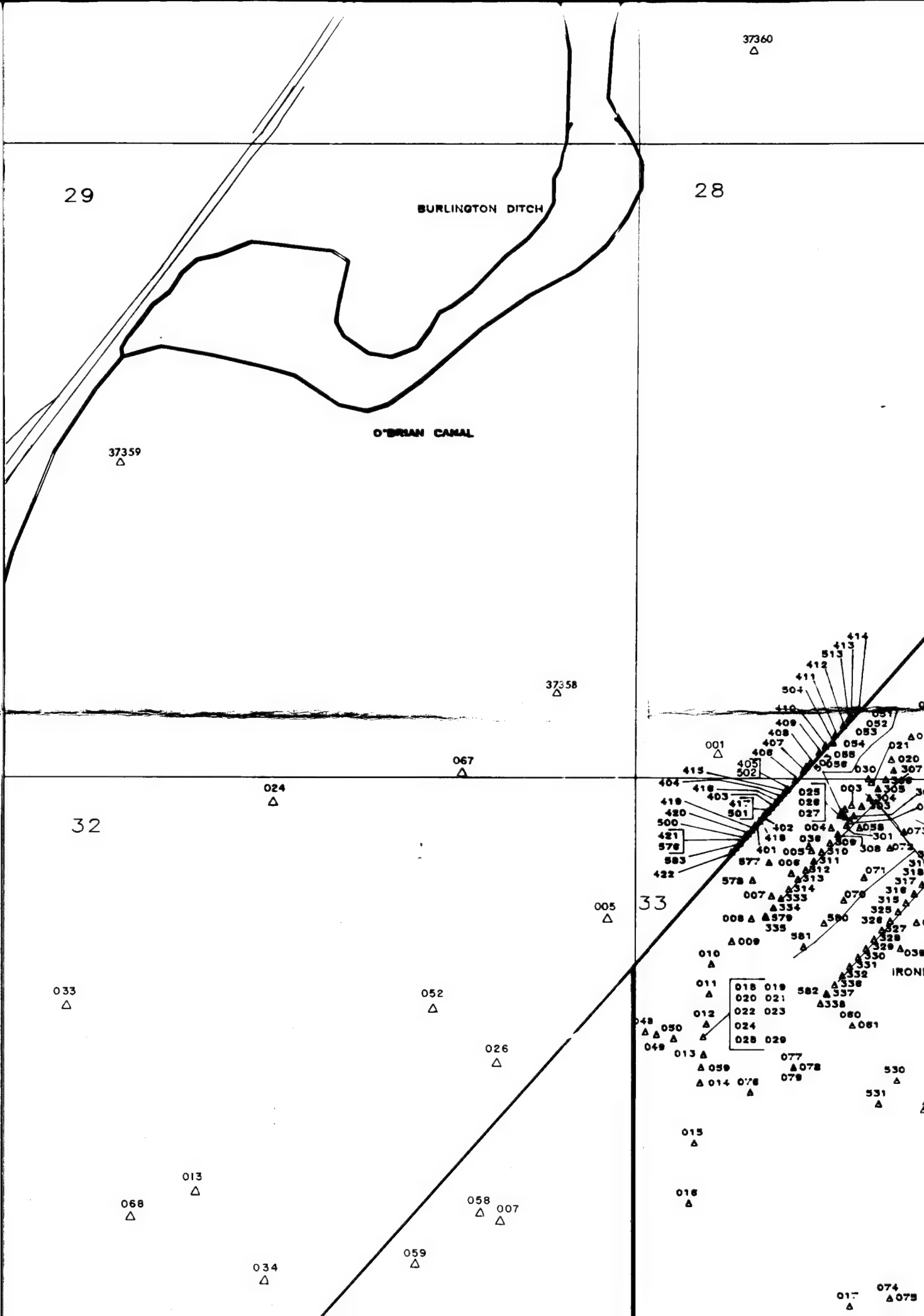
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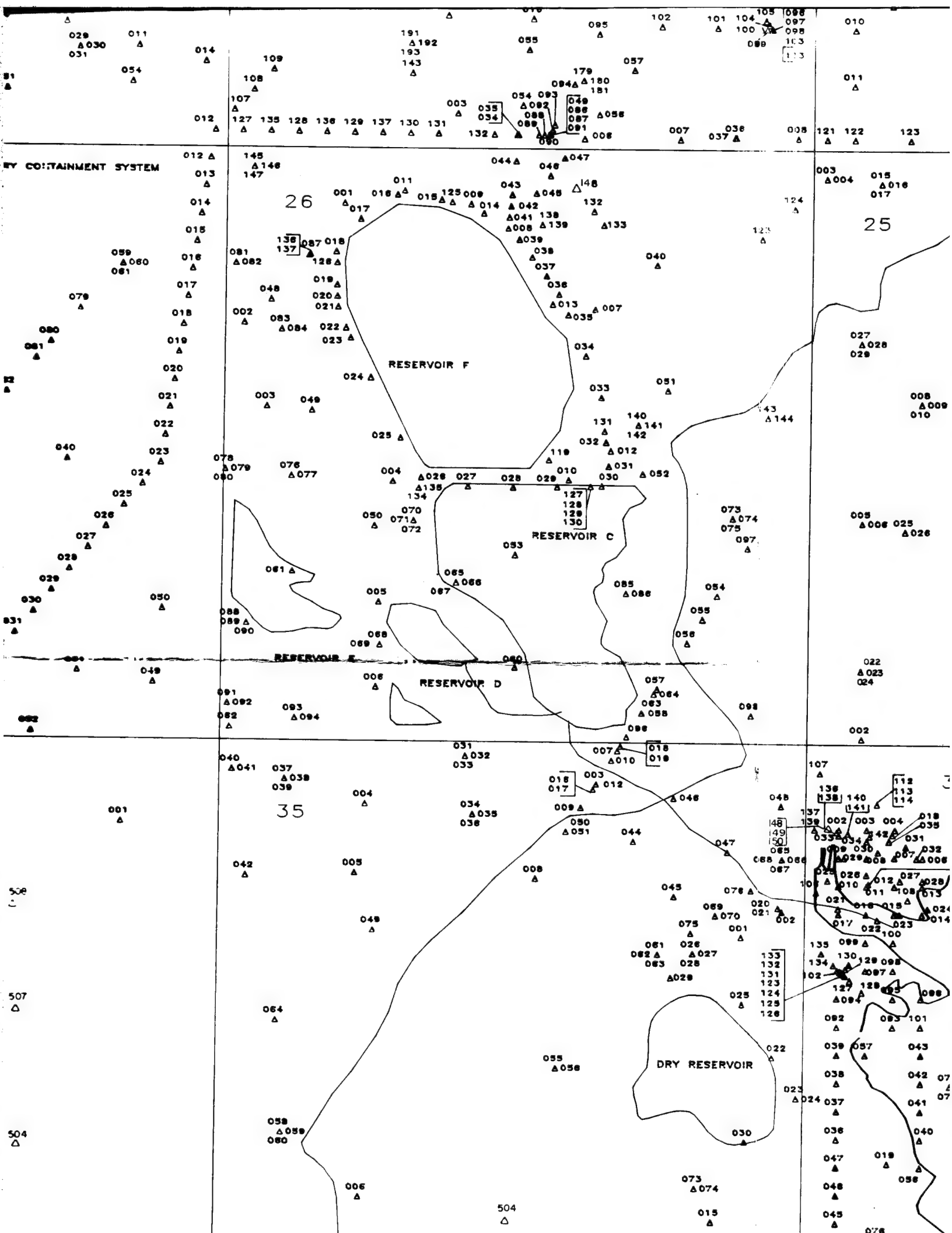
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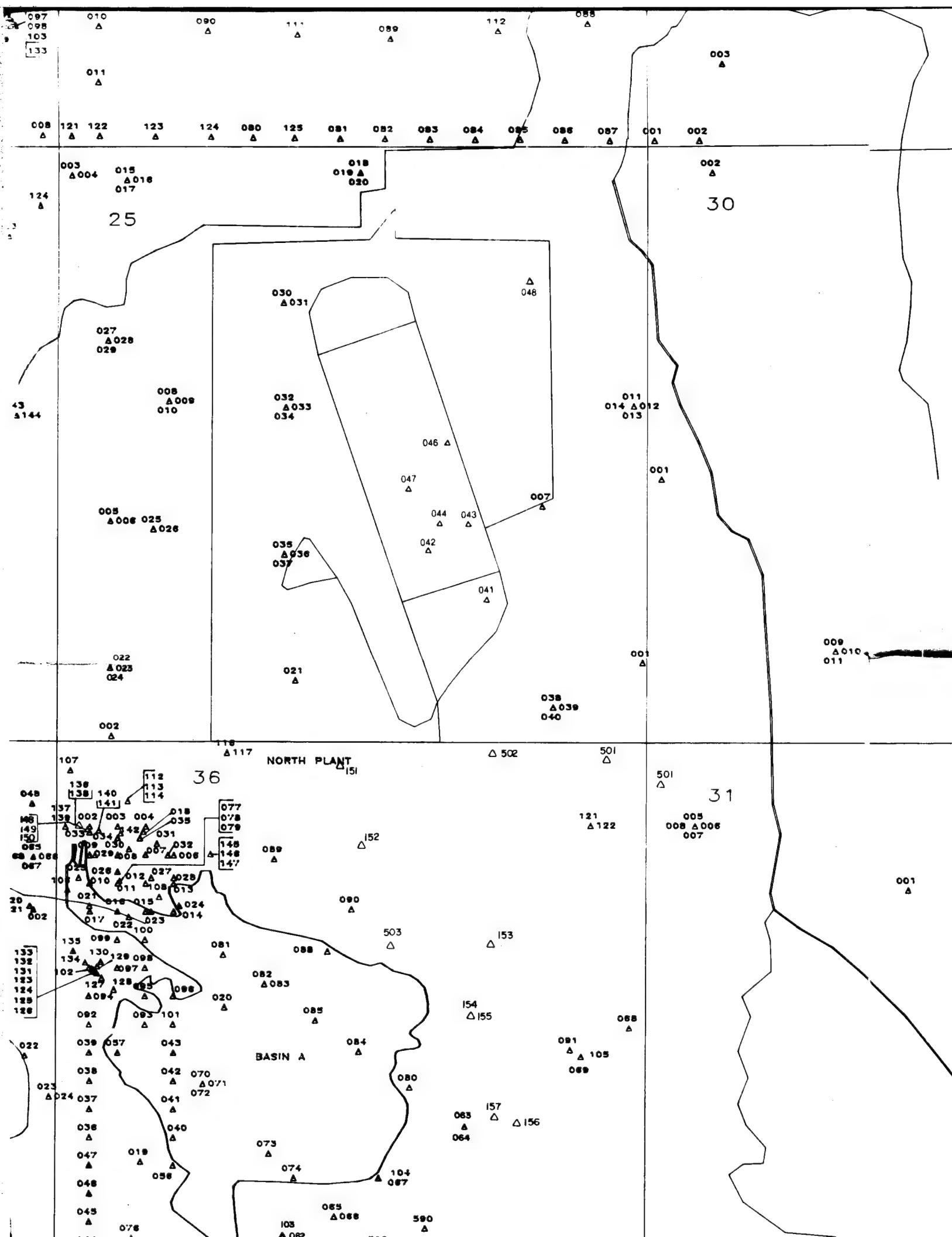
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003  
△

001  
△

002  
△

002  
△

30

006  
△007  
008

29

002  
△003

003  
△004  
005

012  
△

001  
△

009  
△010  
011

501  
△

31

009  
△010  
011

32

001  
△002  
003

005  
008 △006  
007

001  
△

29

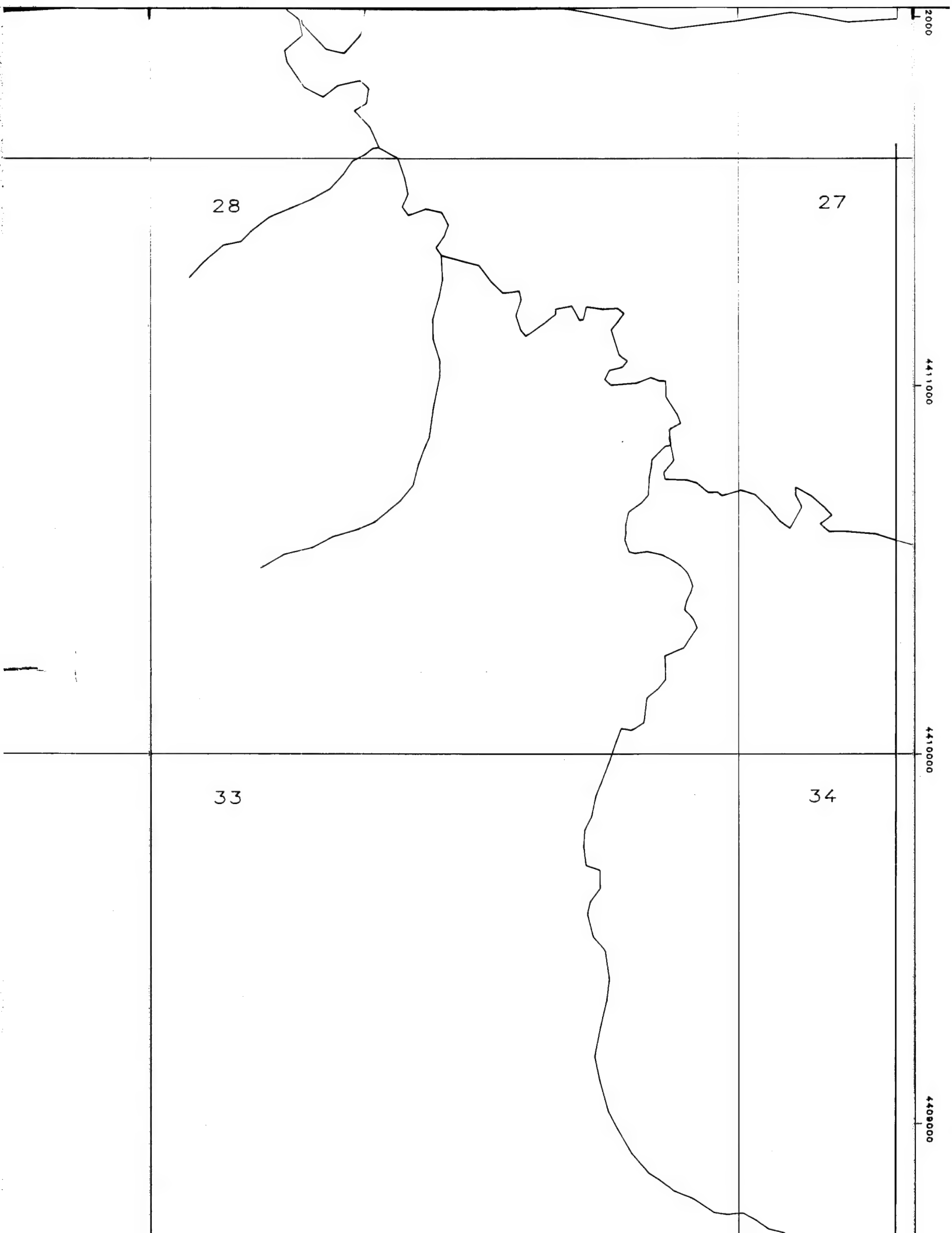
002  
Δ003

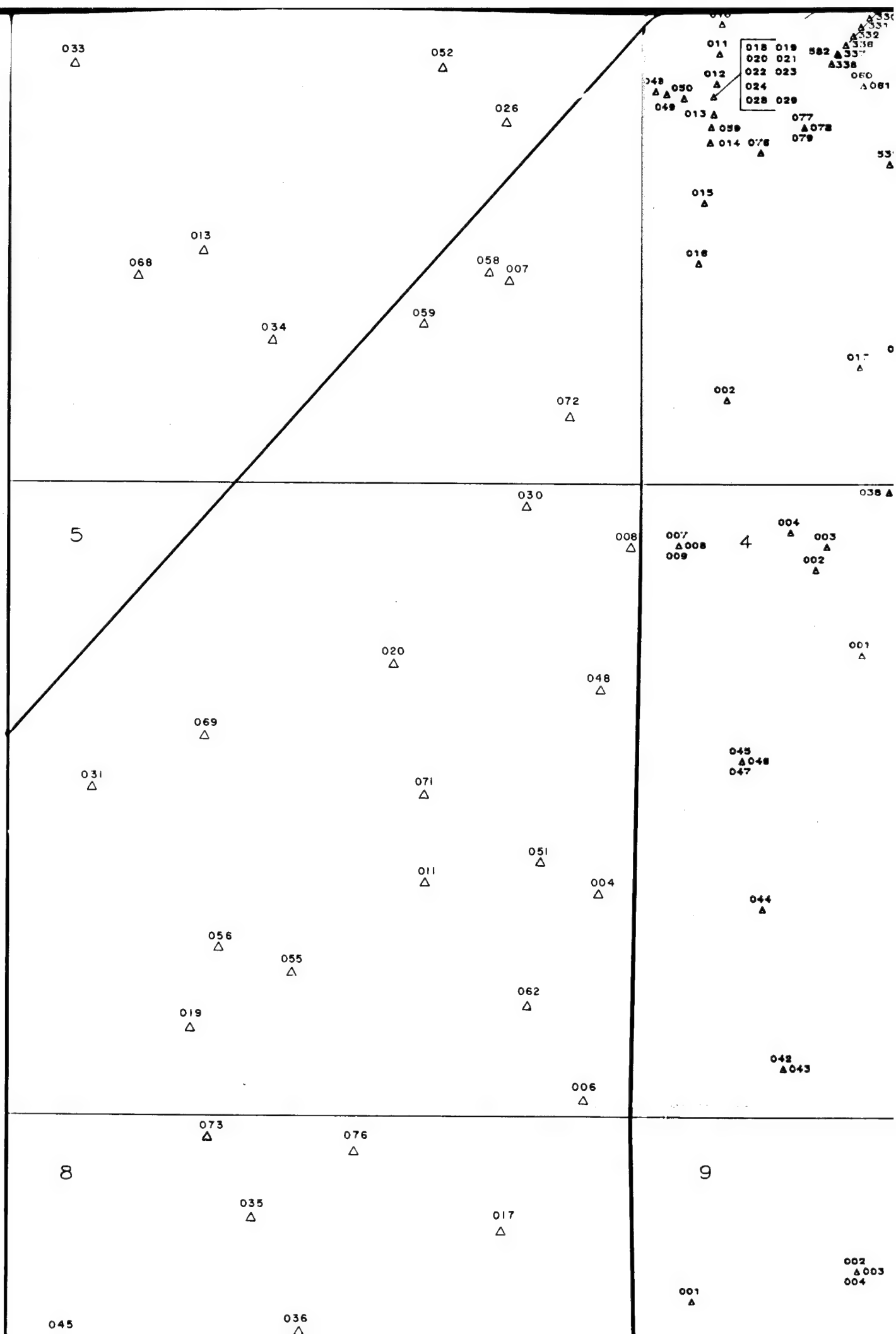
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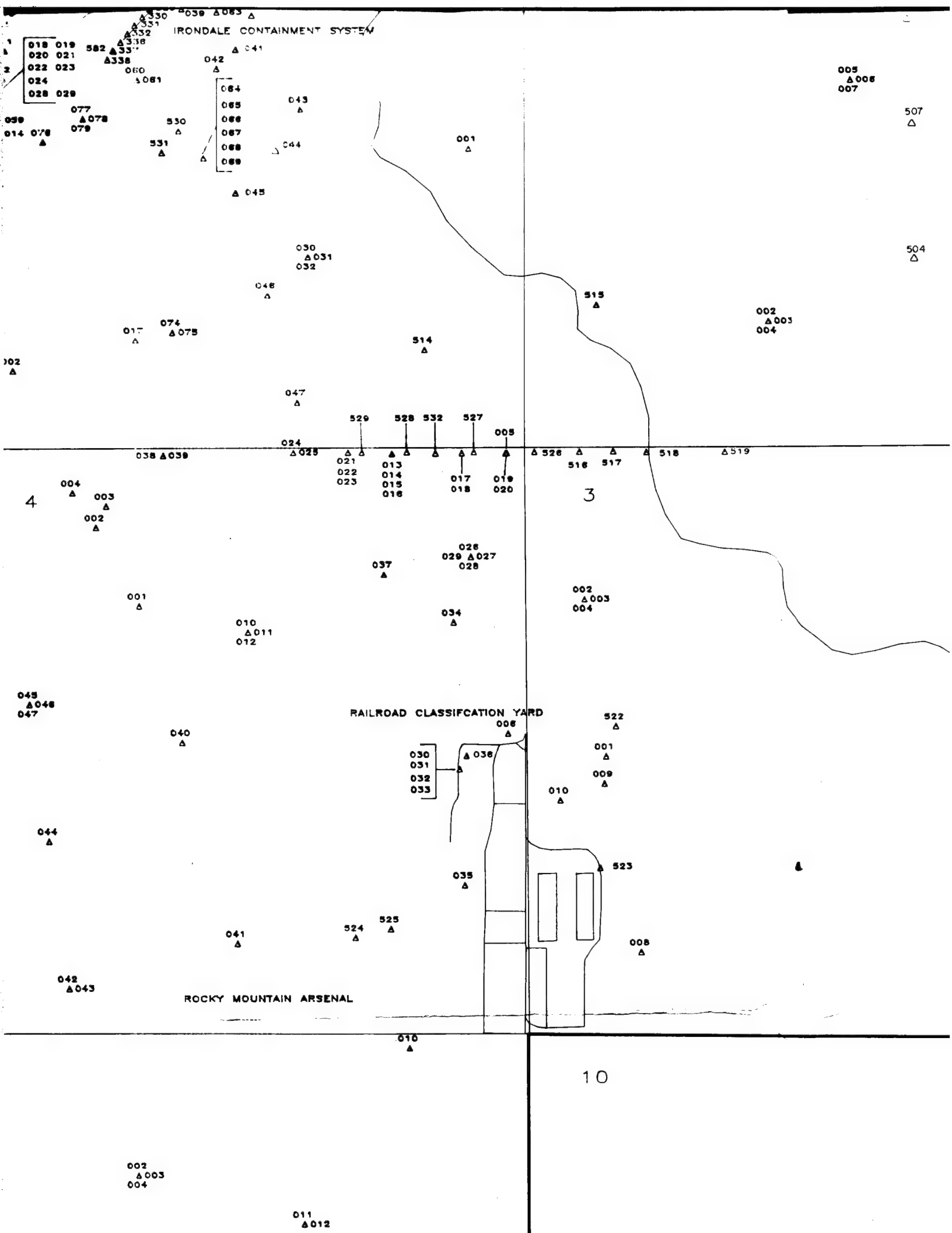
001  
Δ002  
003

33



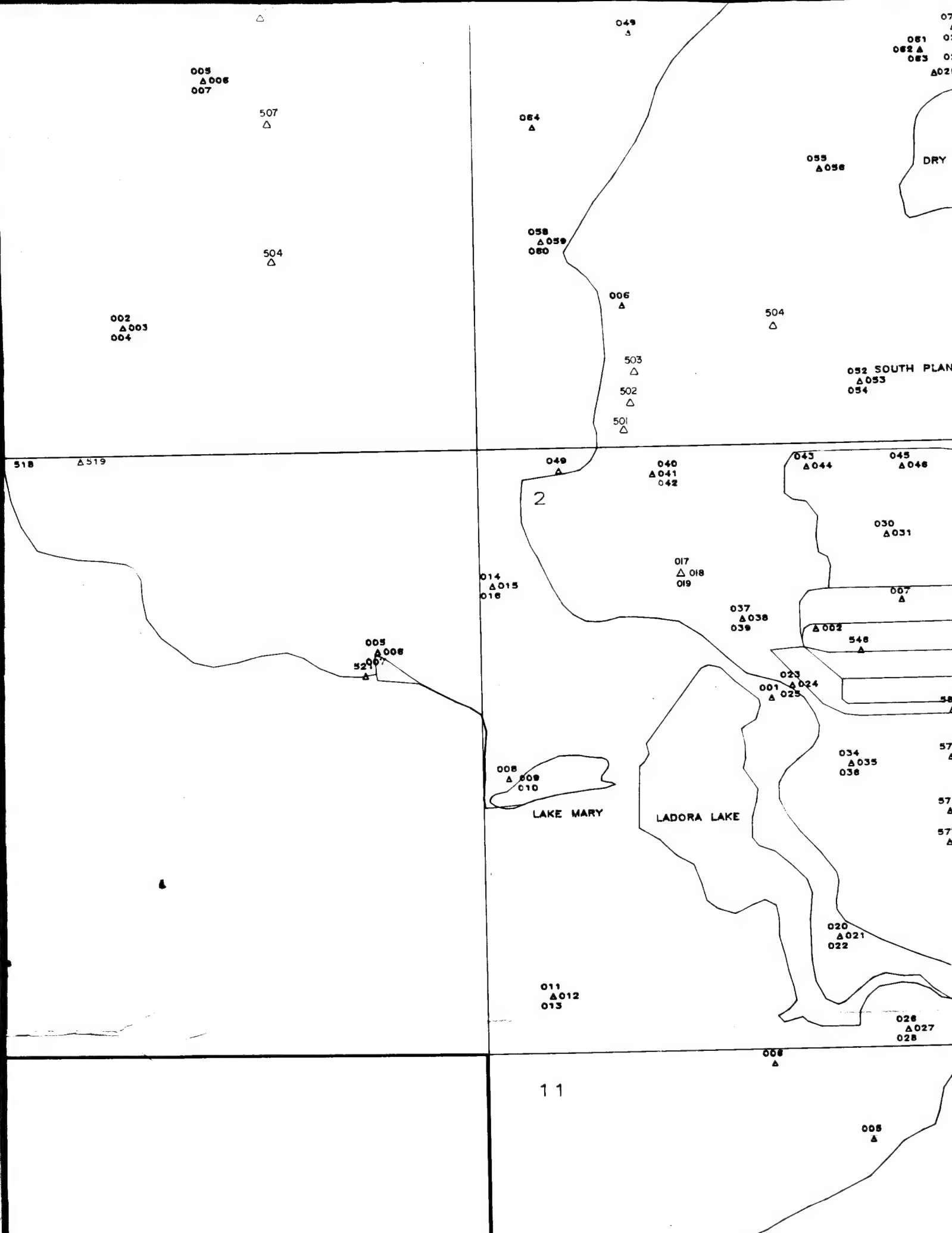


# IRONDALE CONTAINMENT SYSTEM

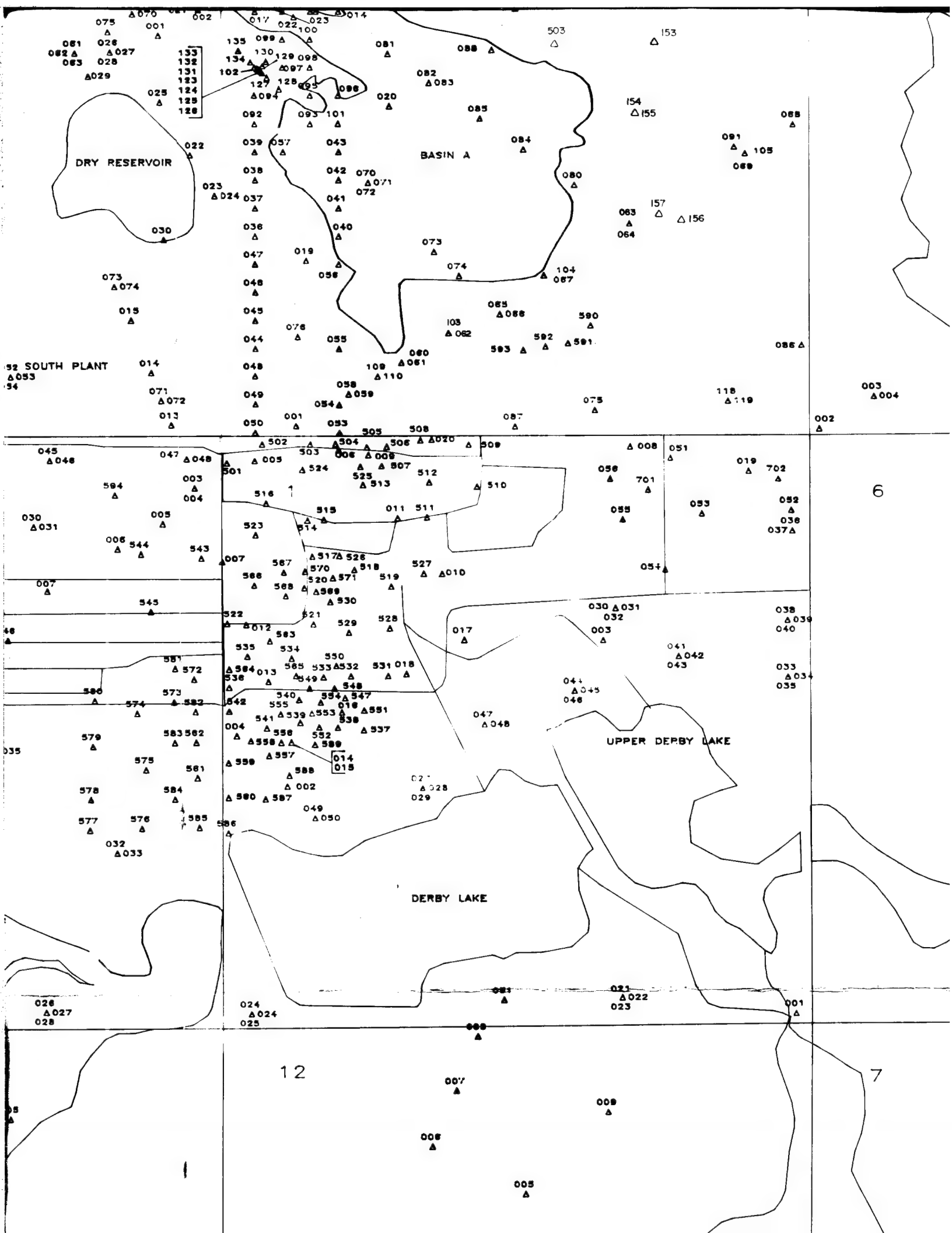


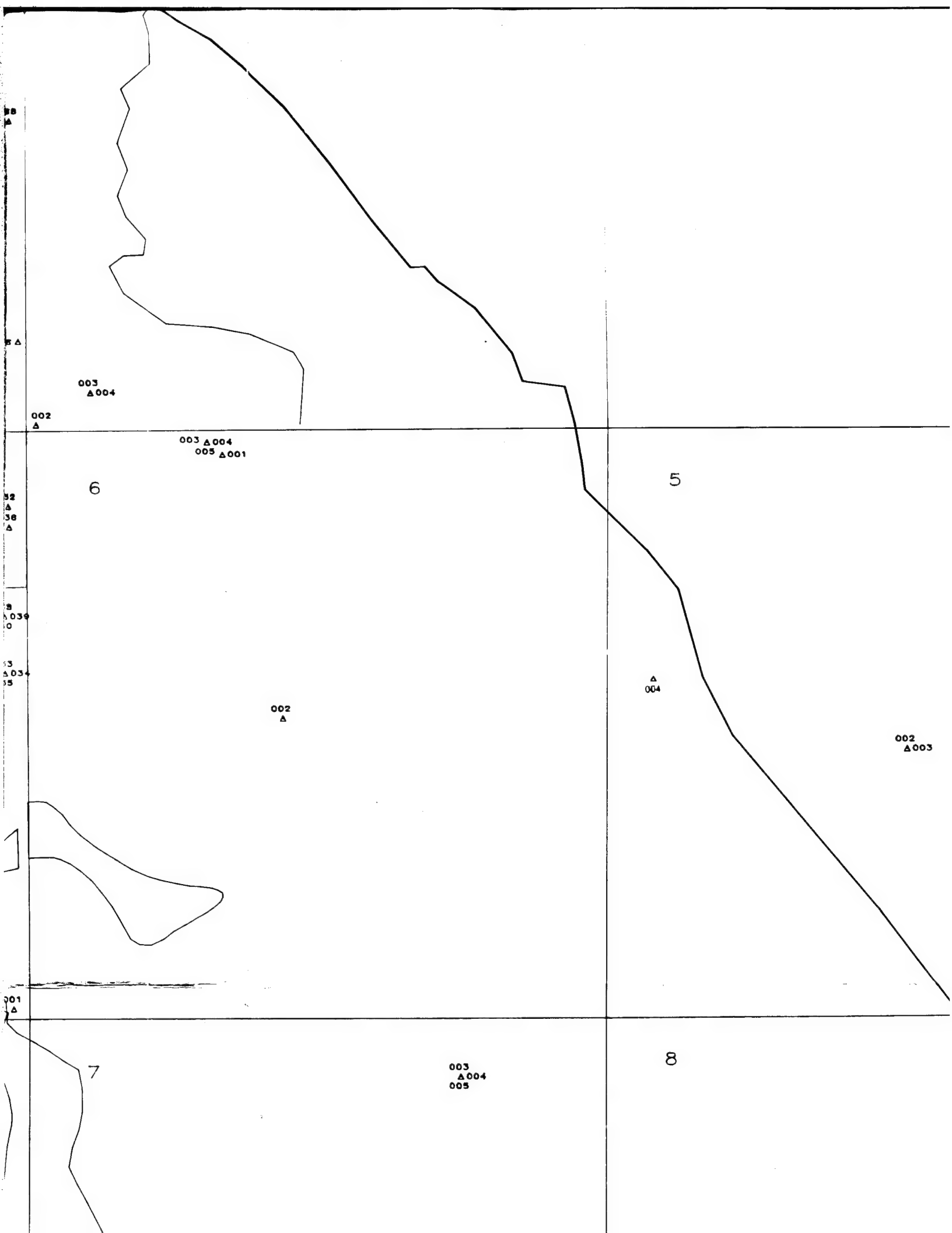
## RAILROAD CLASSIFICATION YARD

## ROCKY MOUNTAIN ARSENAL









001  
Δ

002  
Δ

003  
Δ004

002  
Δ

003 Δ004  
005 Δ001

6

003  
Δ004  
005 Δ001

003  
Δ004  
005 Δ001

003  
Δ004  
005 Δ001

002  
Δ

Δ  
004

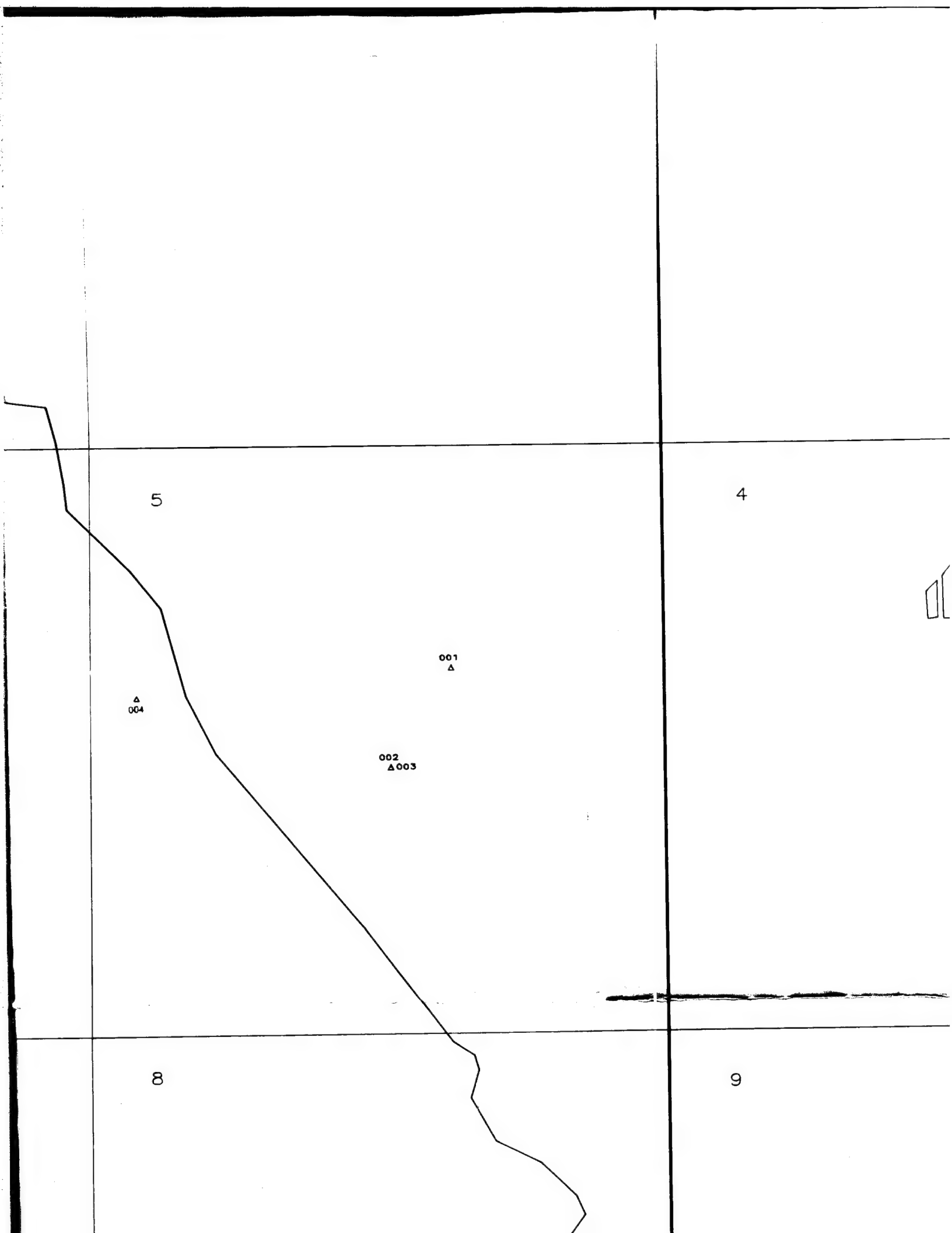
002  
Δ003

001  
Δ

7

003  
Δ004  
005

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001  
Δ

Δ  
004

002  
Δ003

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4408000

4407000

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010  
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004

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011  
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008  
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008  
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007  
Δ

002  
Δ 003  
HAVANA ST. INTERCEPTER Δ 004

HAVANA PONDS

HAVANA ST. INTERCEPTER

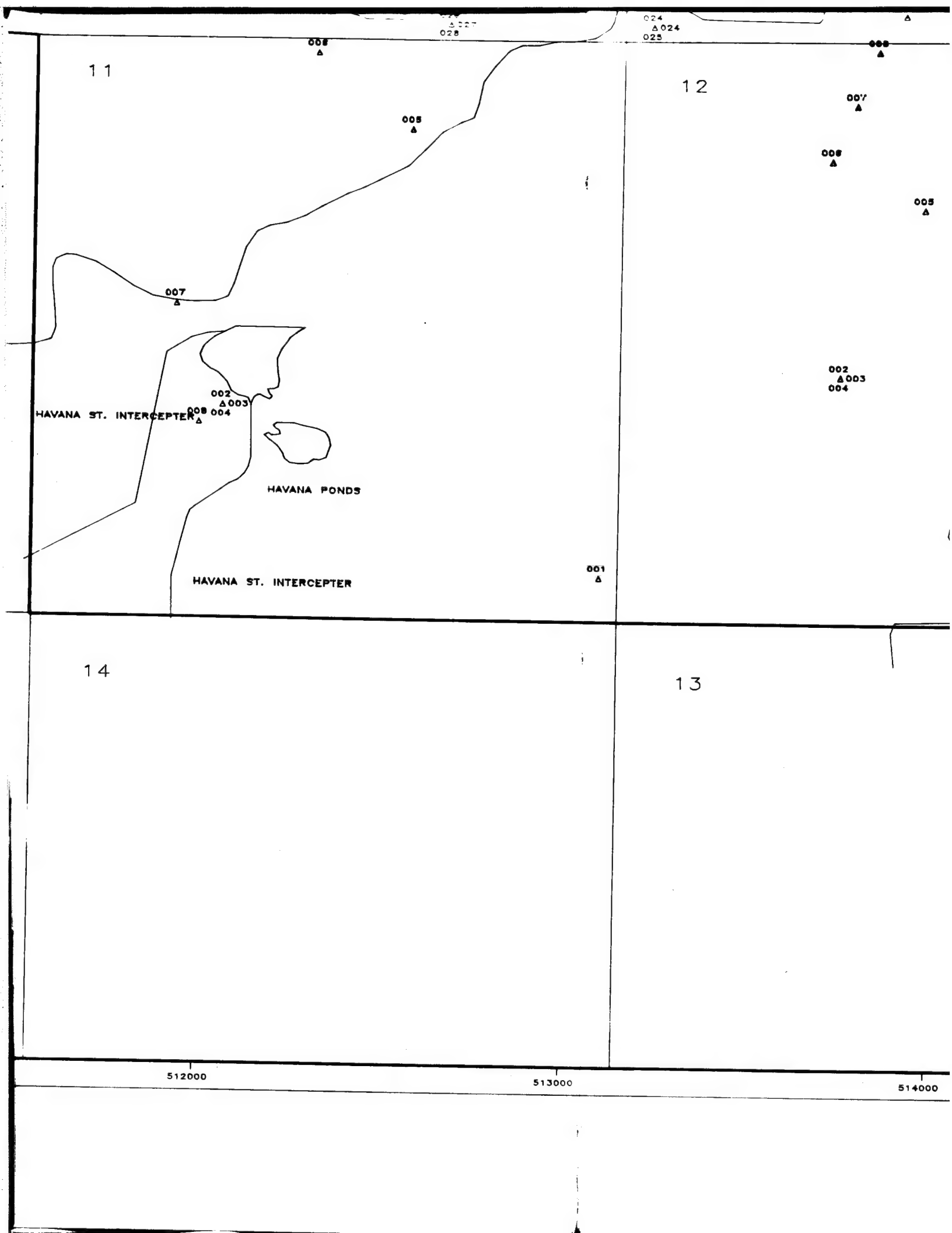
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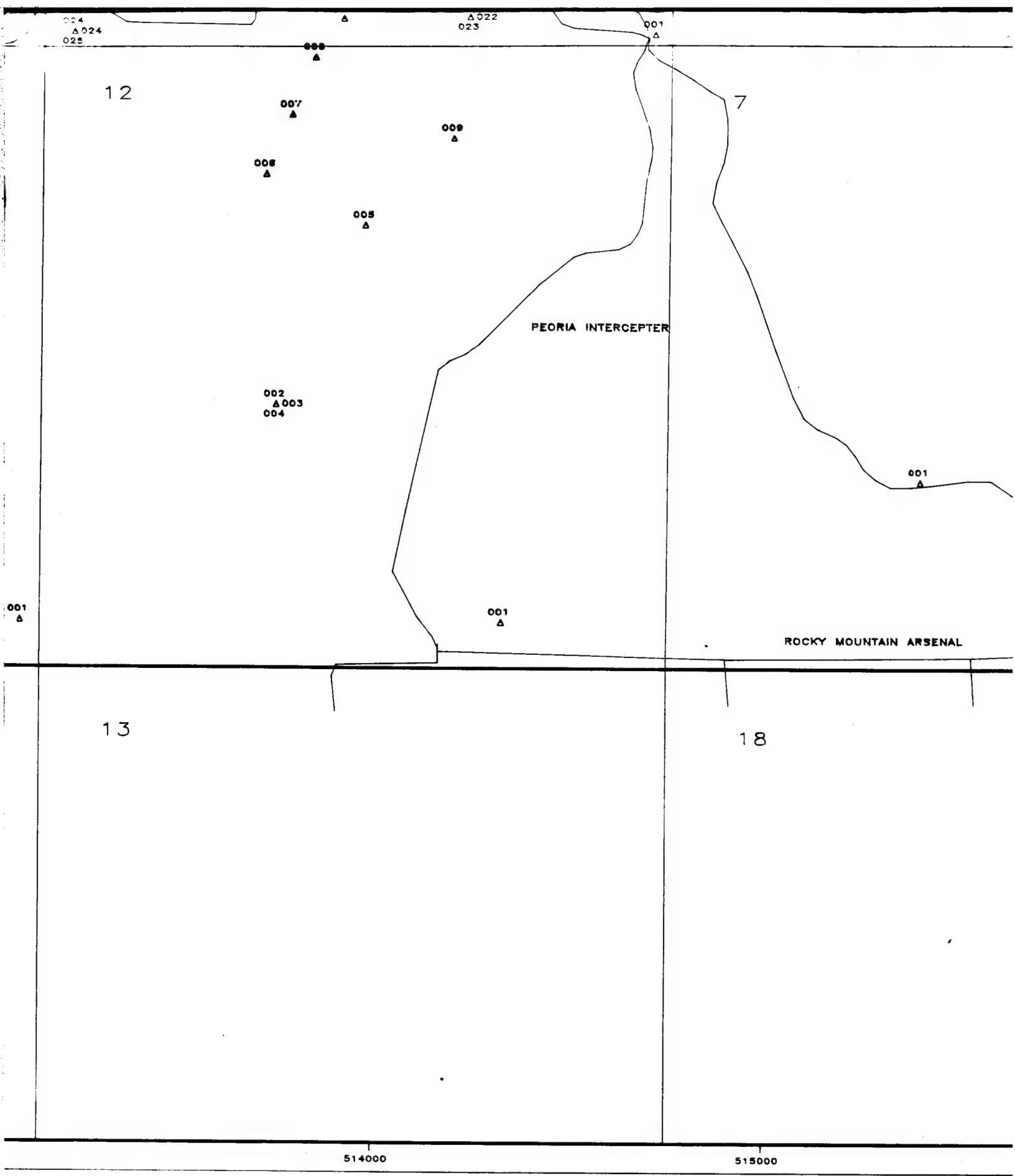
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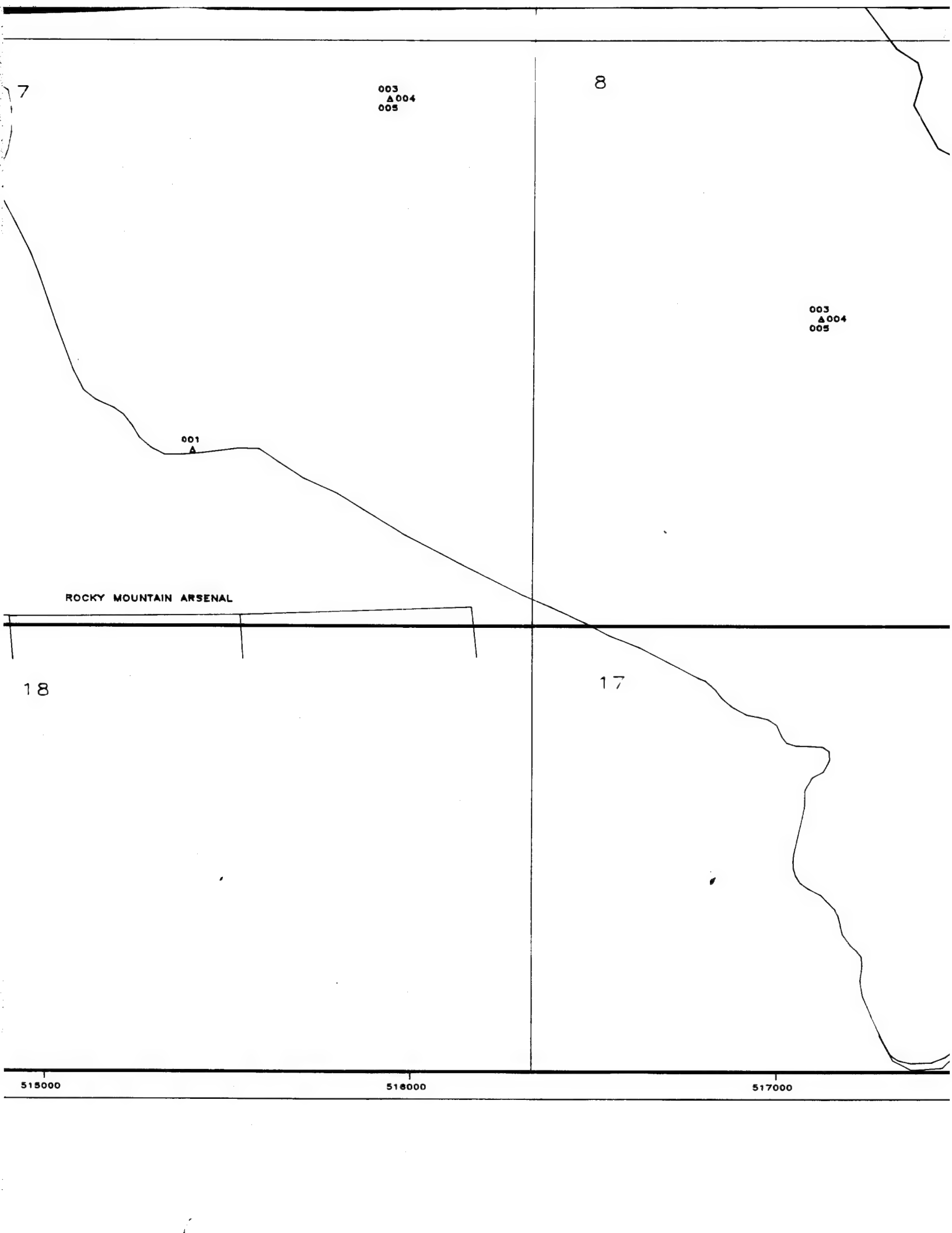
511000

512000









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003  
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005

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003  
A004  
005

001  
A

ROCKY MOUNTAIN ARSENAL

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517000

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003  
Δ 004  
005

37366

002  
Δ

FIRST CREEK

17

16

**Plate 2**

85930-046

ON AND OFF

DRAWING NO. DRAWING TI

85930

1"

ESE PROJECT NUMBER SC/

④

③

②

①

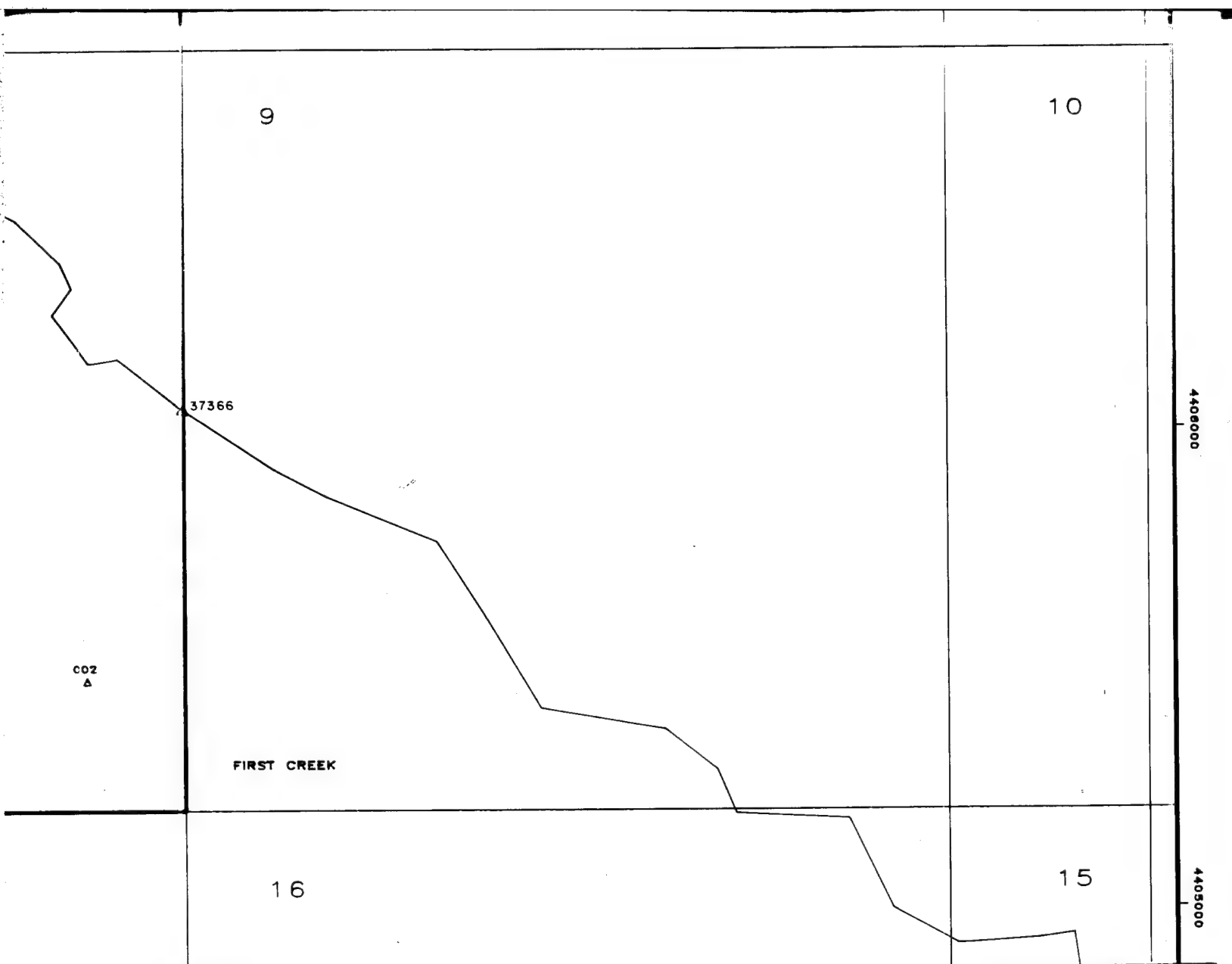
Revised J.L., 1-13-88

DRAWN/REVISED

BY CH

1000

517000



FILE LOCATION :

**Plate 2**

85930-046 ON AND OFFPOST GROUND WATER MONITORING WELL LOCATION MAP, FEB. 1987  
DRAWING NO. DRAWING TITLE

85930	1" 1000'
ESE PROJECT NUMBER	SCALE
④	
③	
②	W B Updated 7/88
① Revised J.L., P.C.	3/87 1-87
	9-86
DRAWN/REVISED	BY CHK'D DATE

**ESE ENVIRONMENTAL SCIENCE AND ENGINEERING, INC.**  
AN RSC COMPANY

D. Stephens	1-87
APPROVED FOR ISSUE BY	DATE

R68W R67W

13

24

R67W

18

17

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17

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**16**

**15**

**21**

**22**



15

14

22

South Platte River

23

4900

4910

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4930

4940

R67W | R66W

13

river

24

4940  
4940  
4950

R67W | R66W

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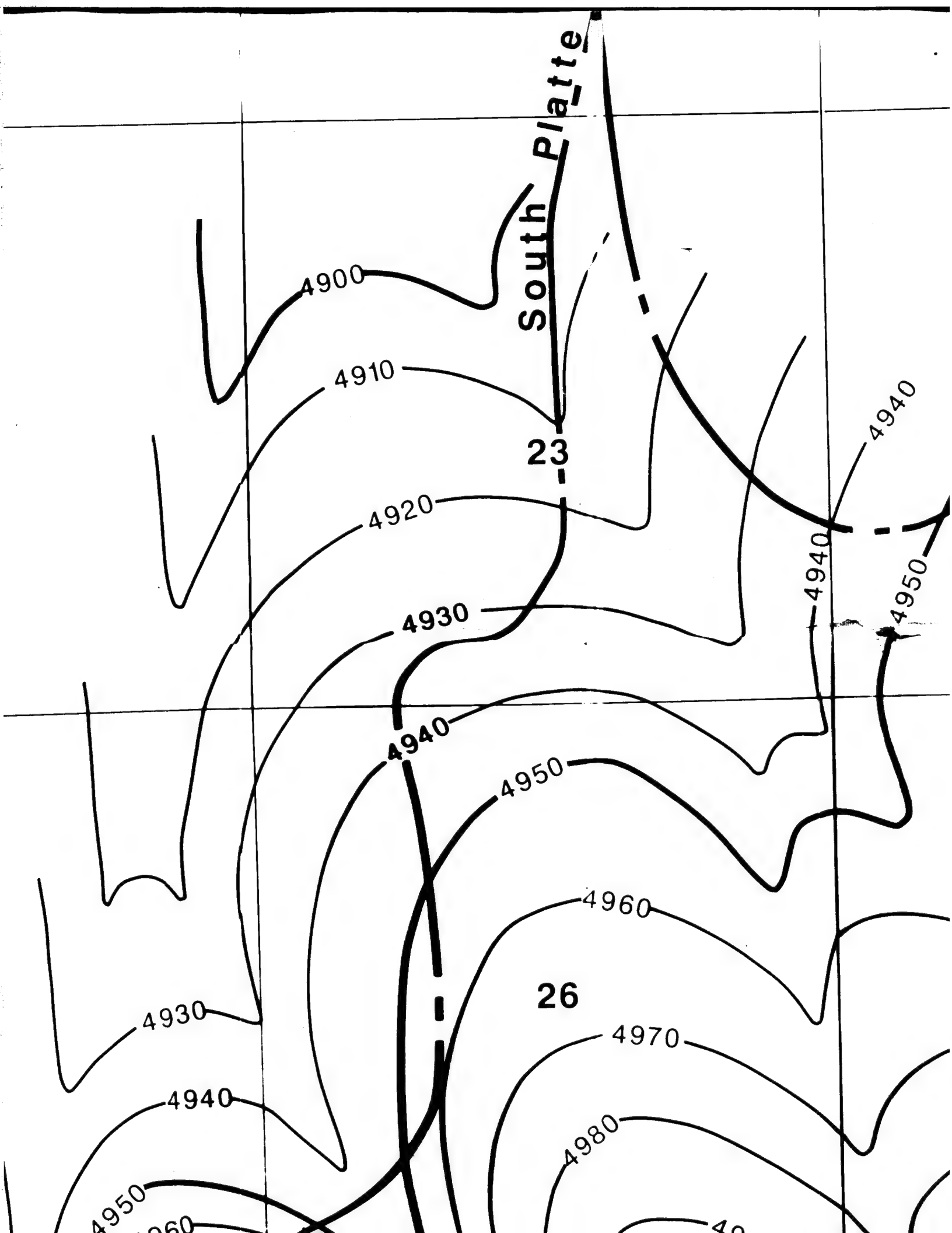
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494

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South Platte

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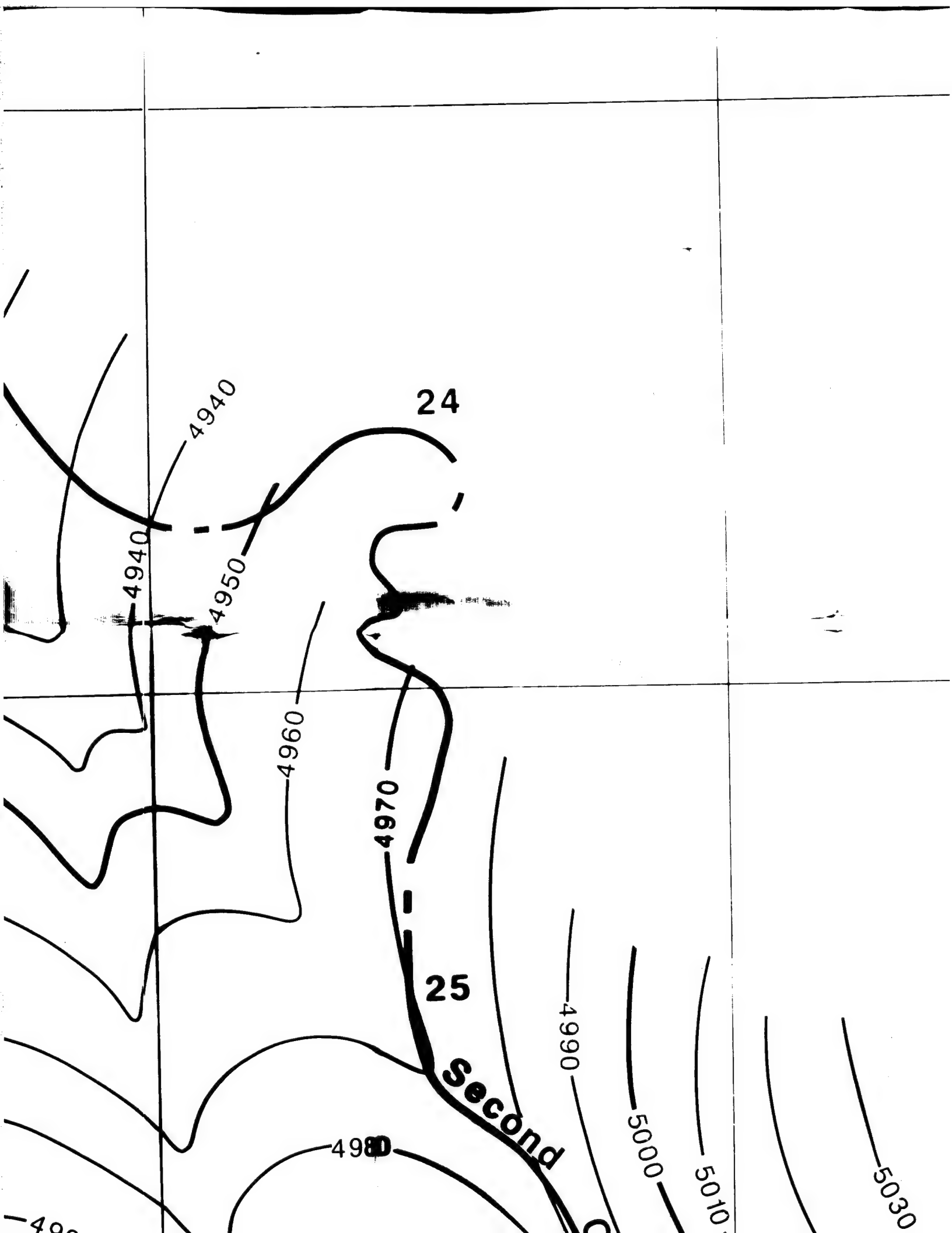
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**25**

**36**

**30**

**29**

**31**

**32**

**29**

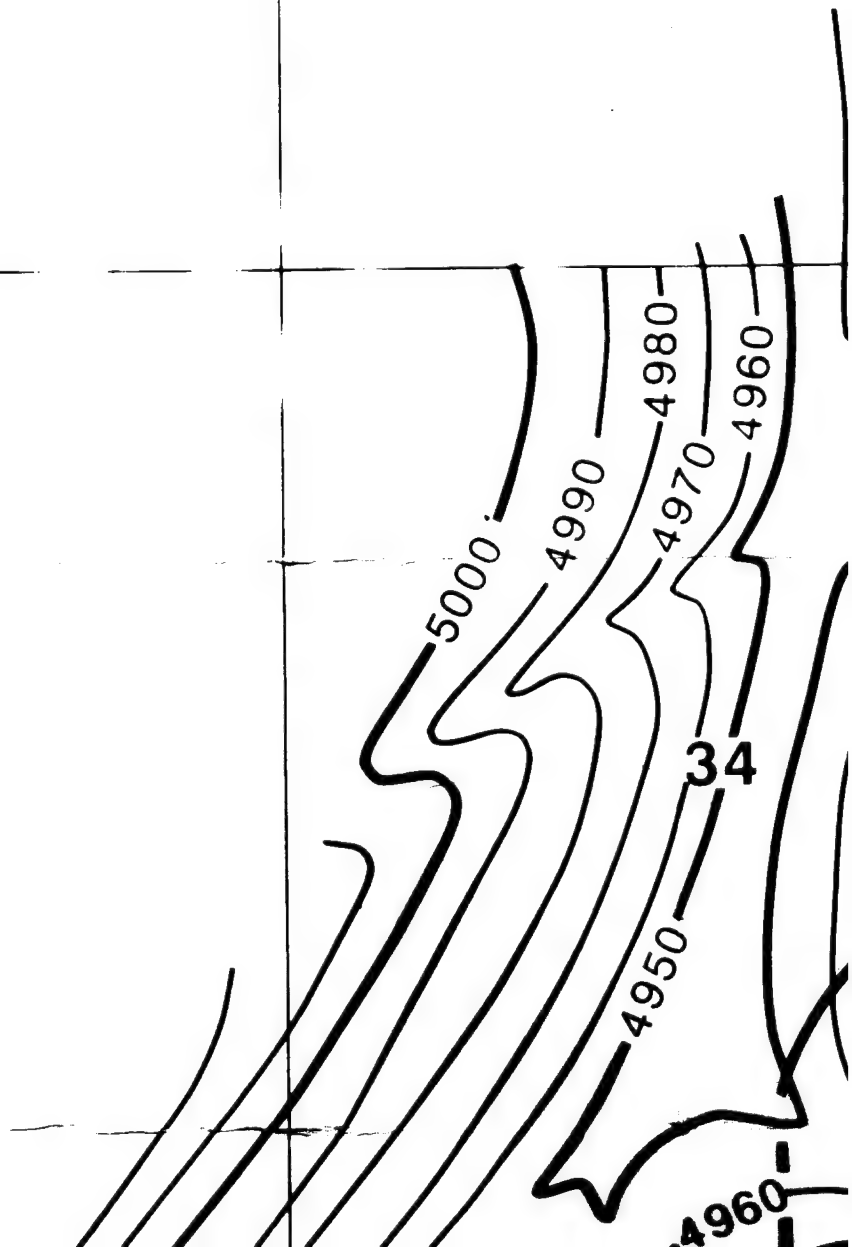
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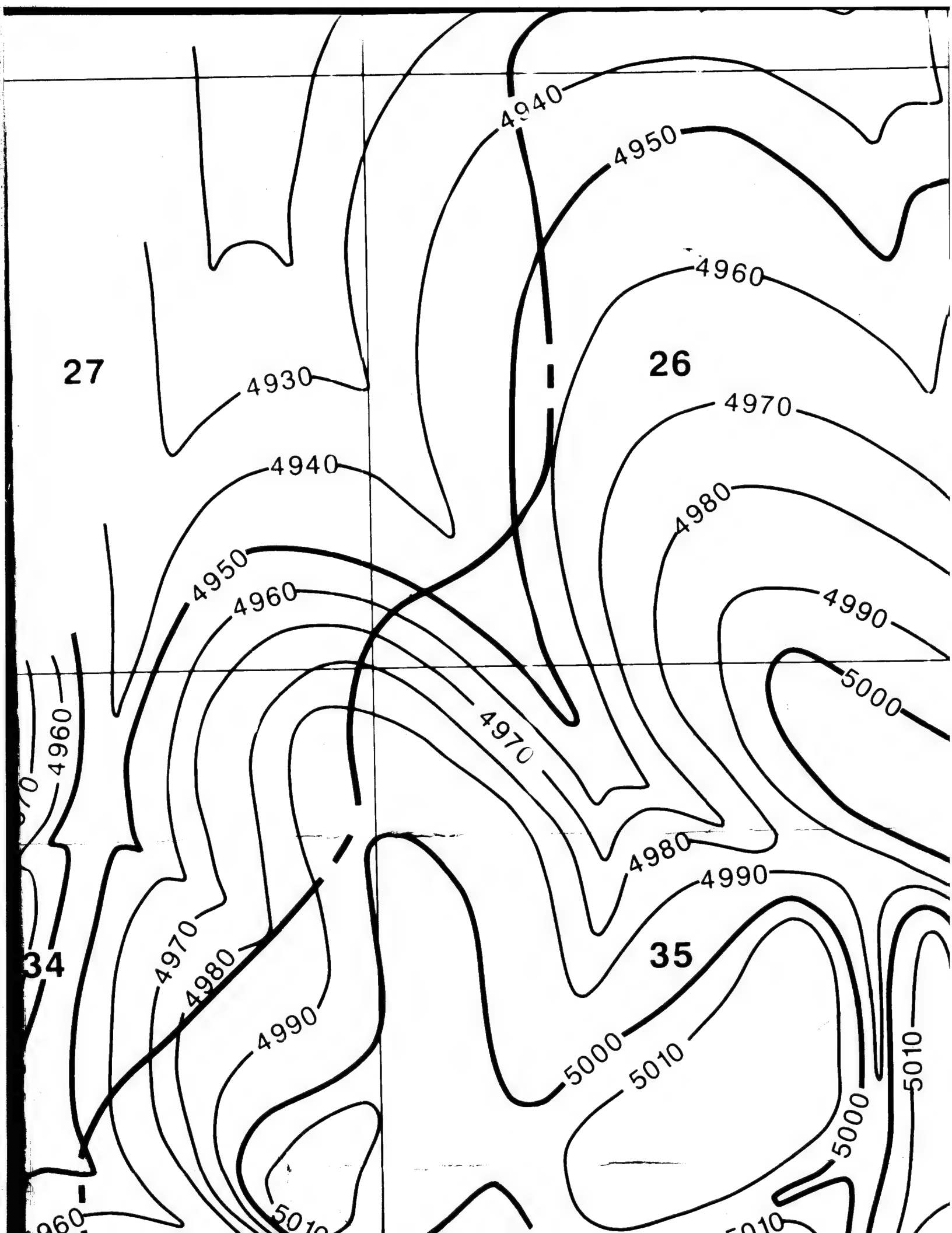
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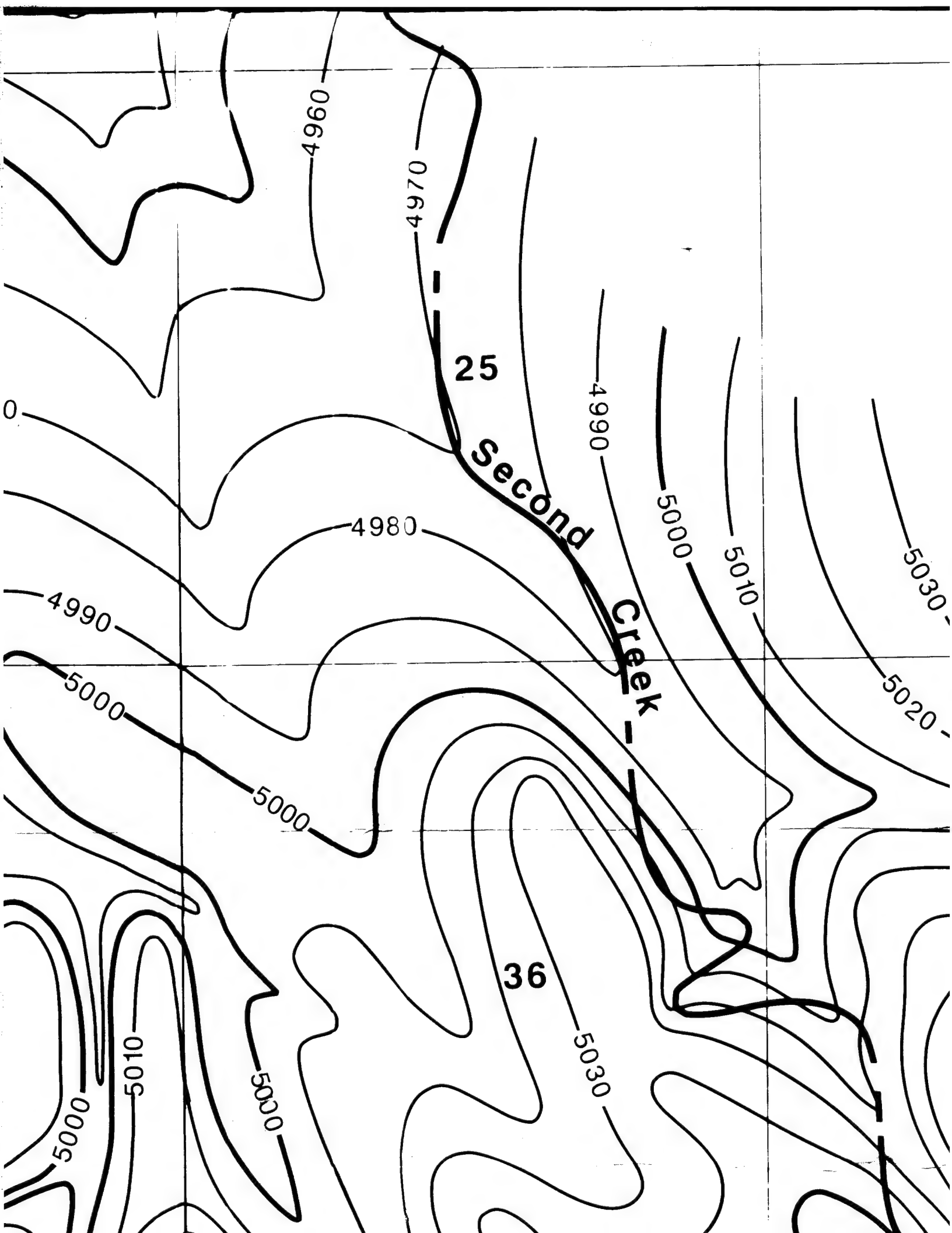
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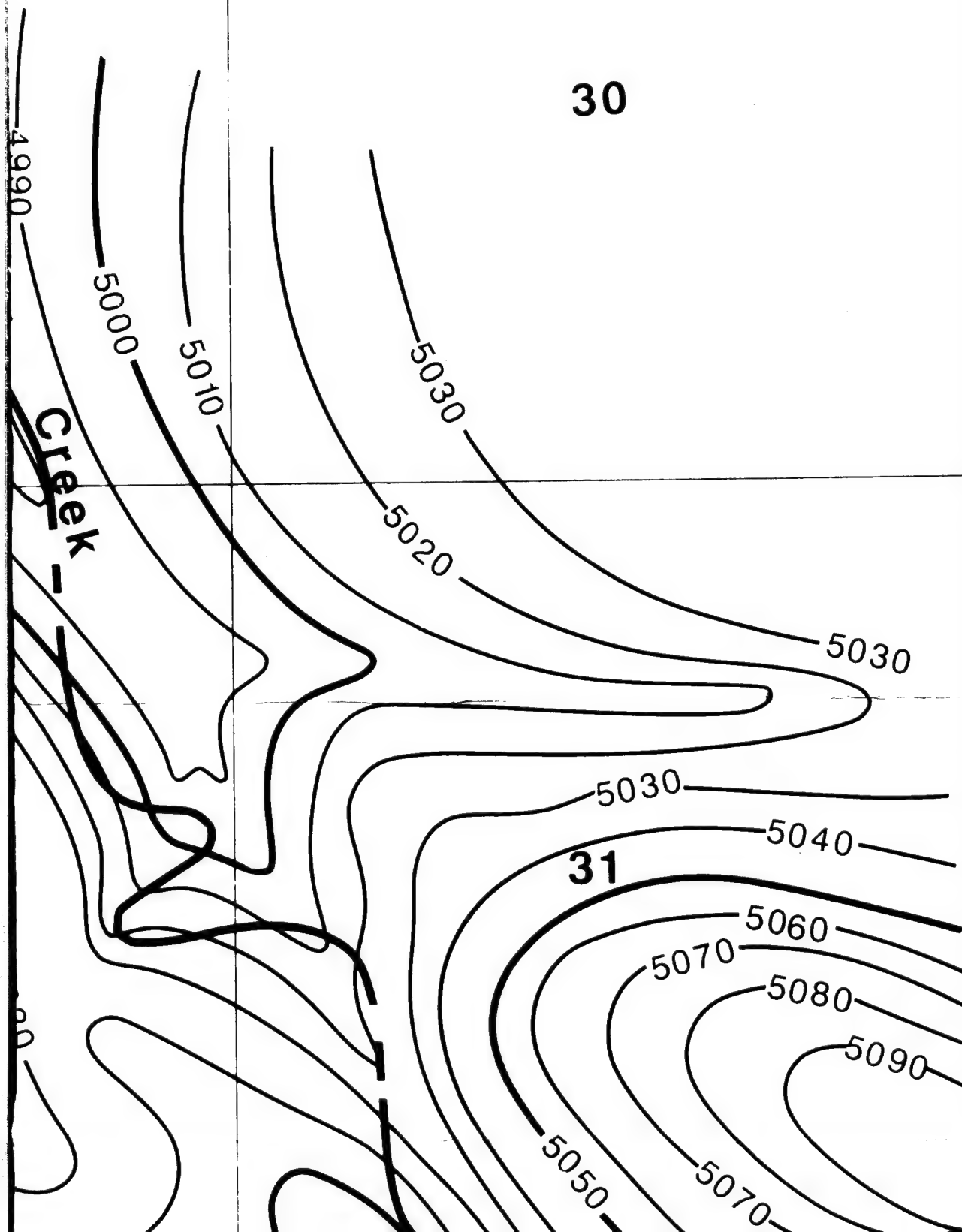
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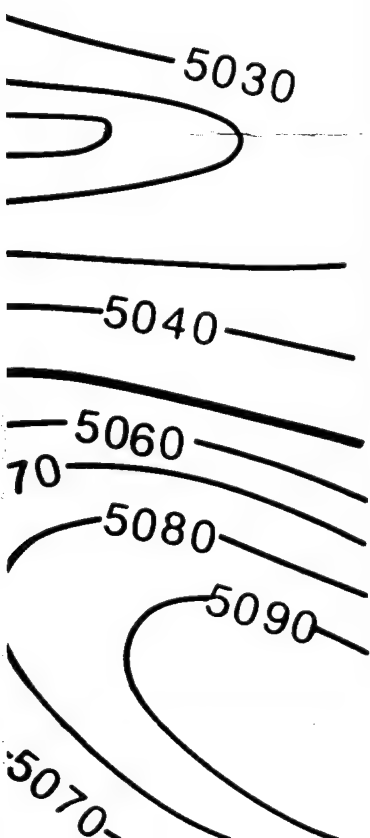


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T1S

T1S  
T2S

1

12

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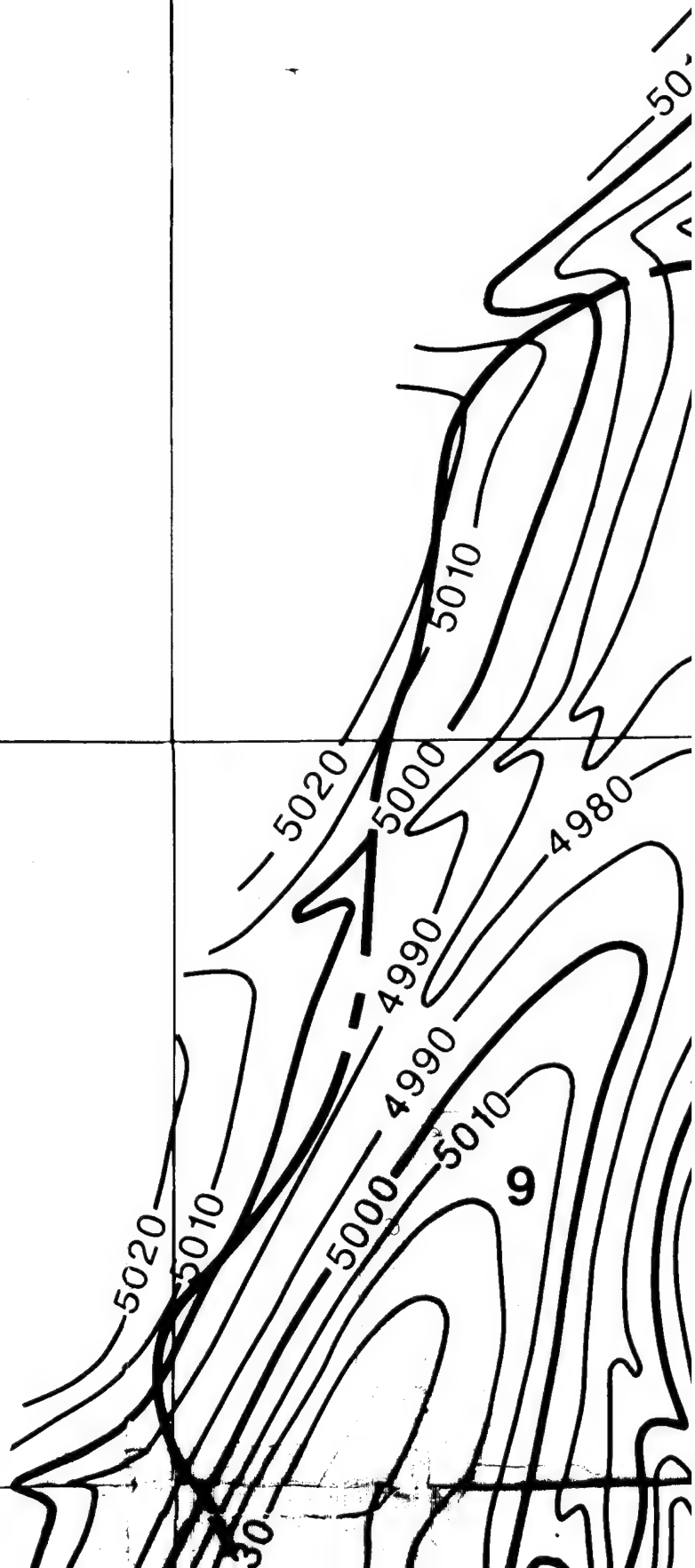
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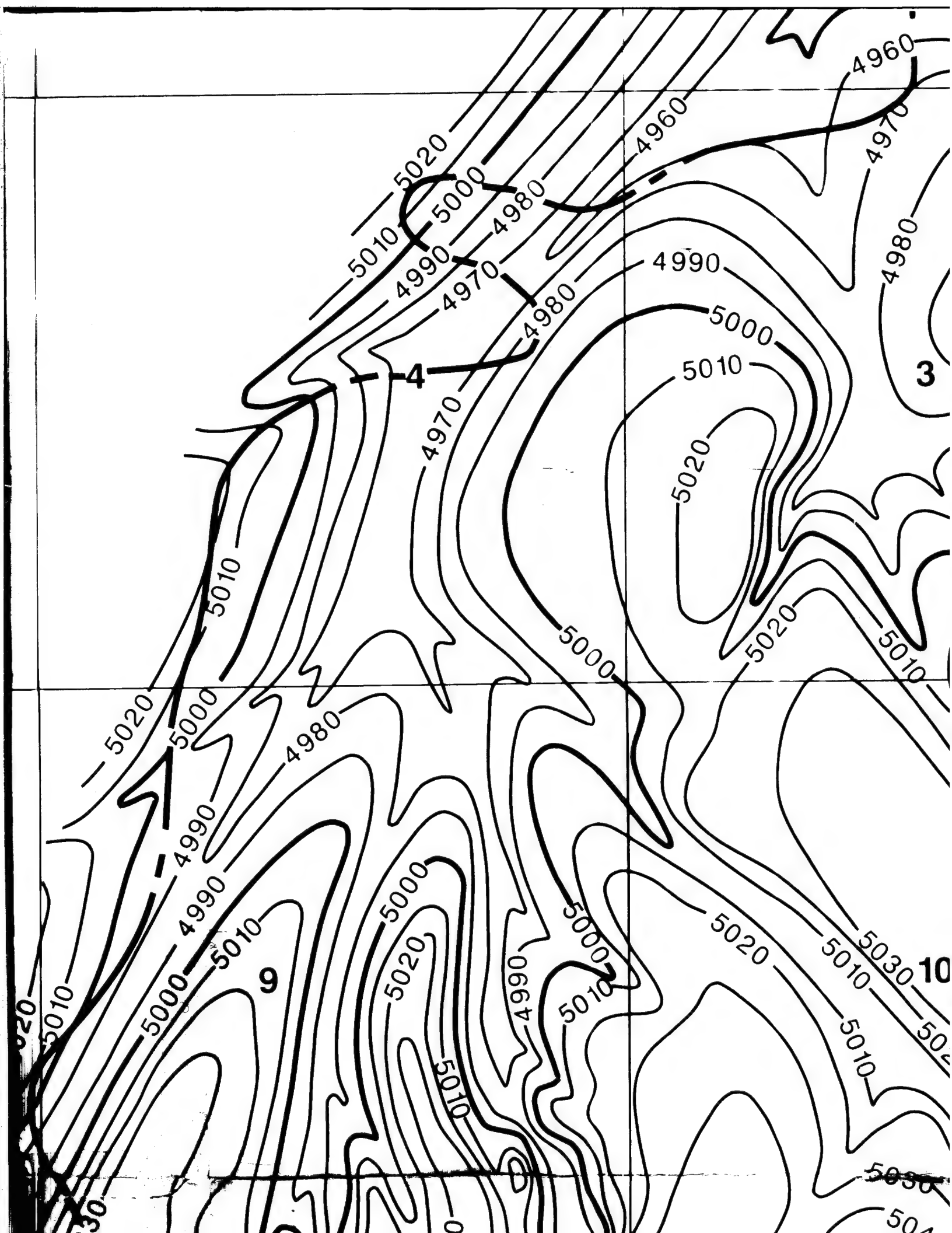
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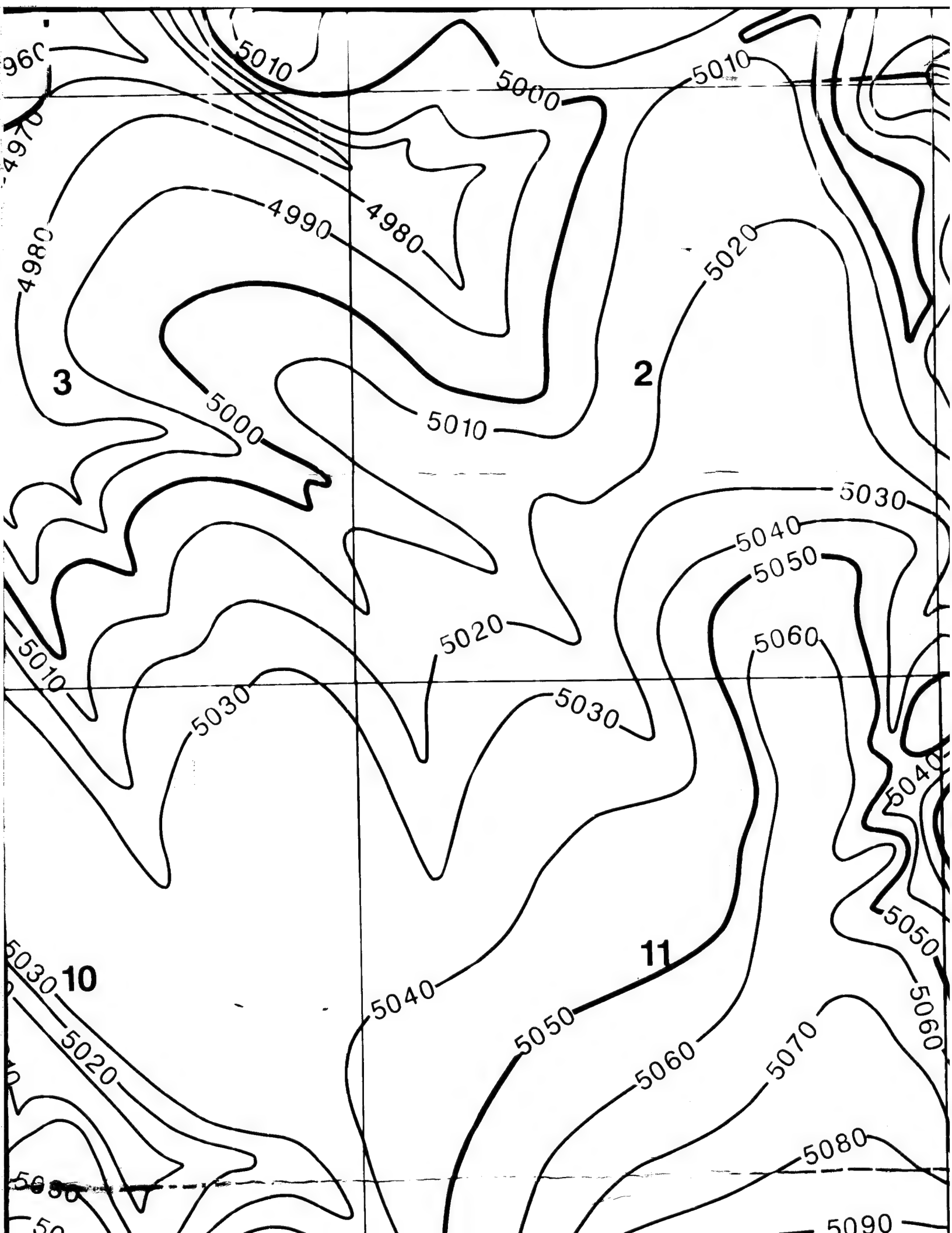
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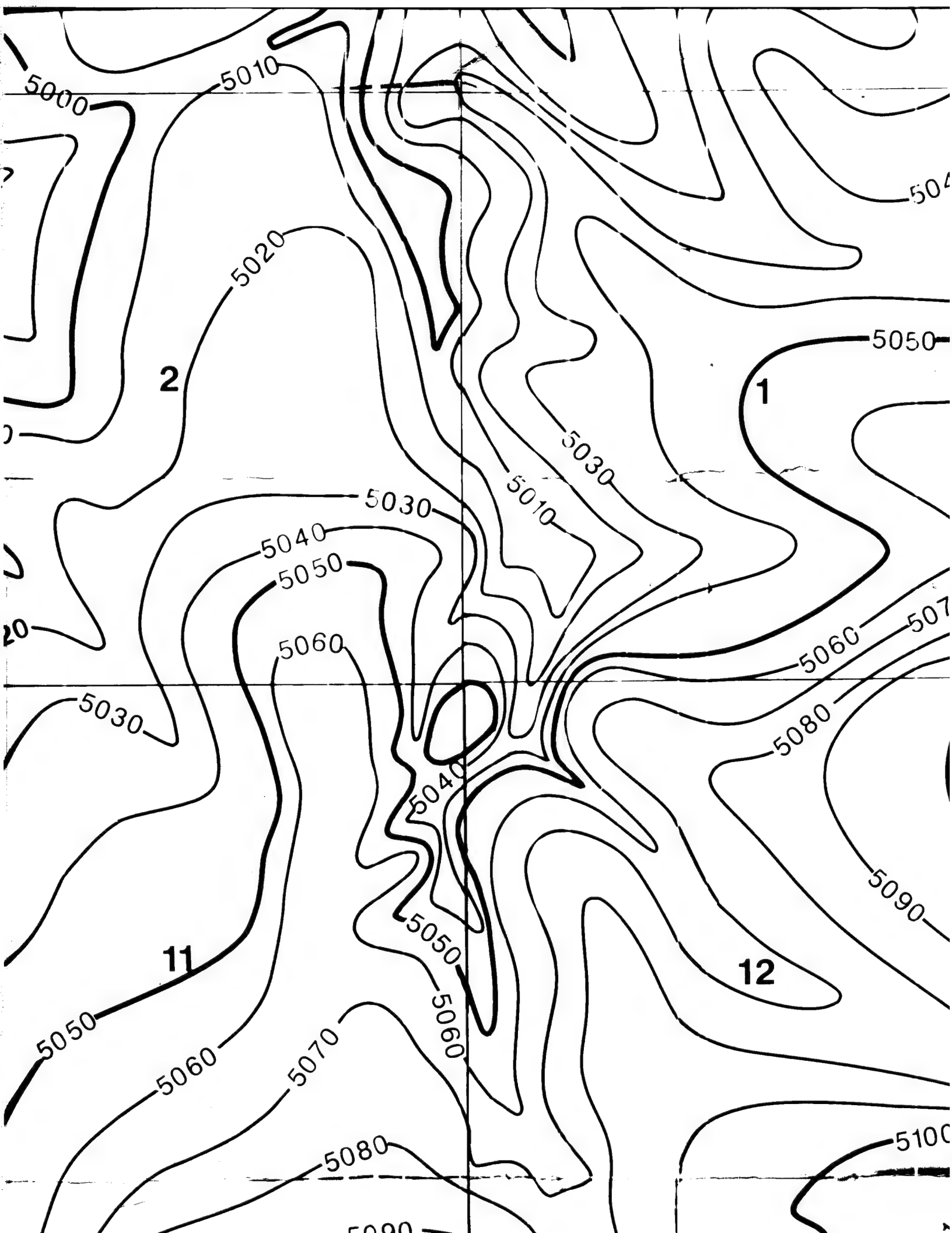
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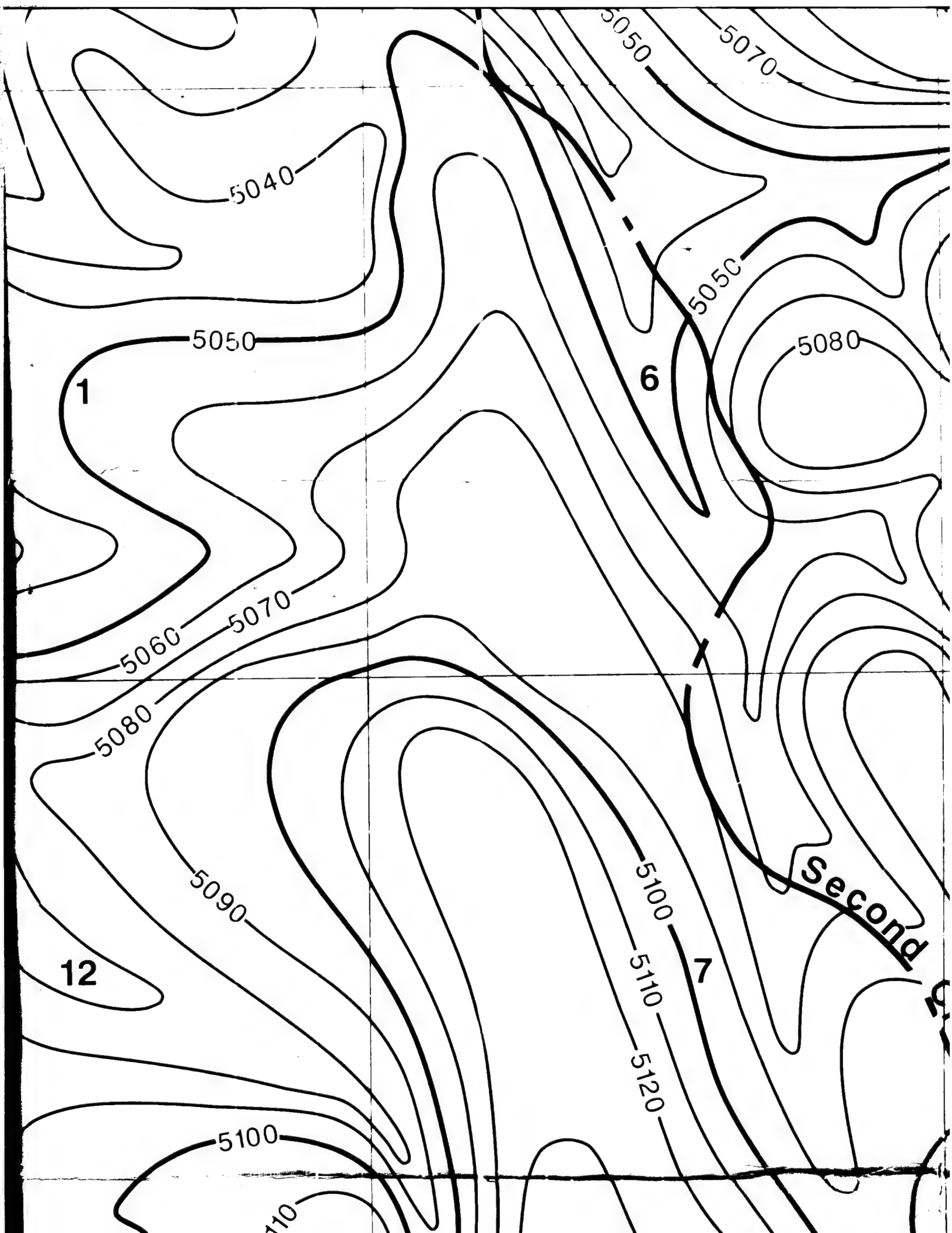




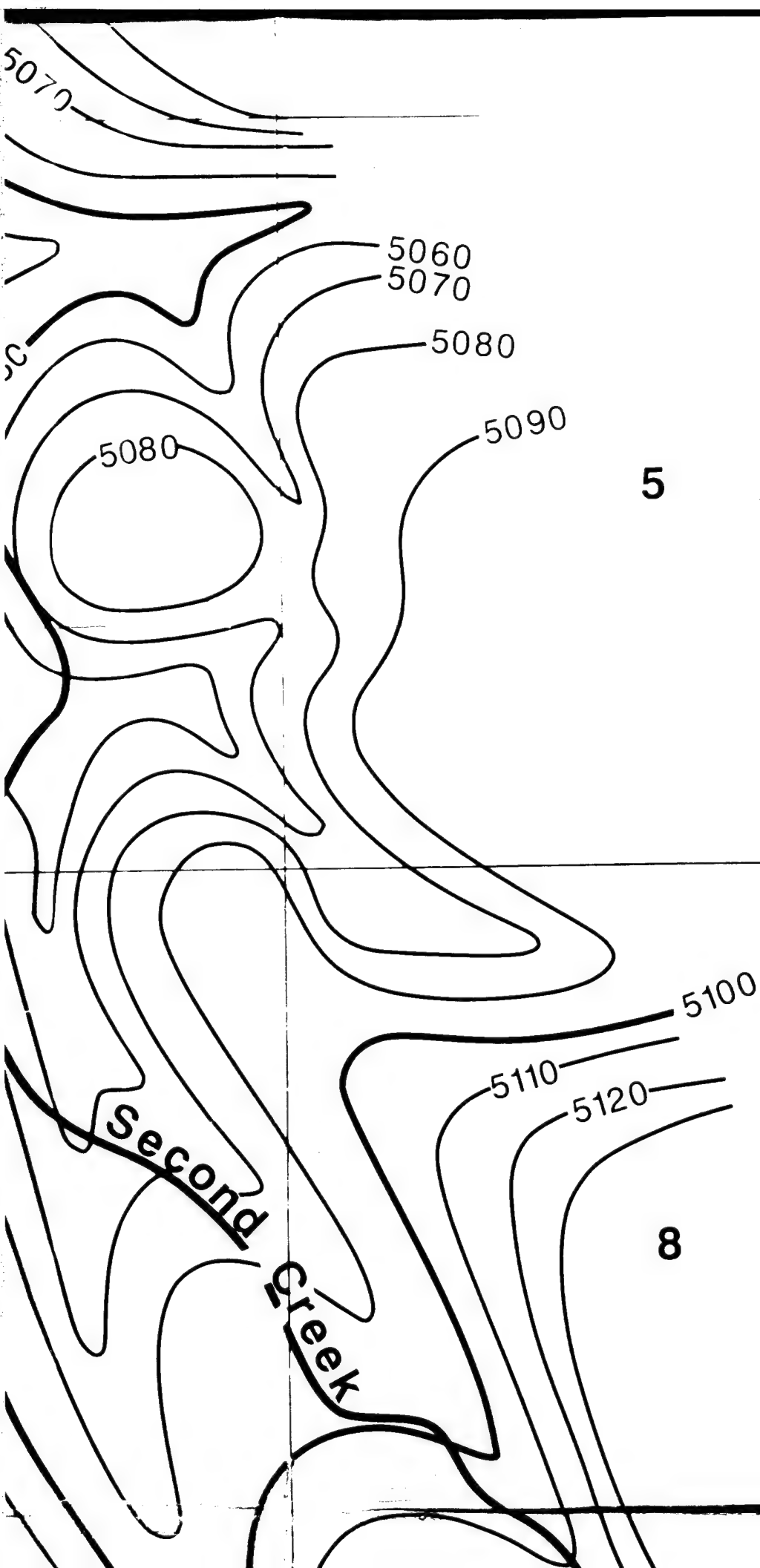








T1S  
T2S



13

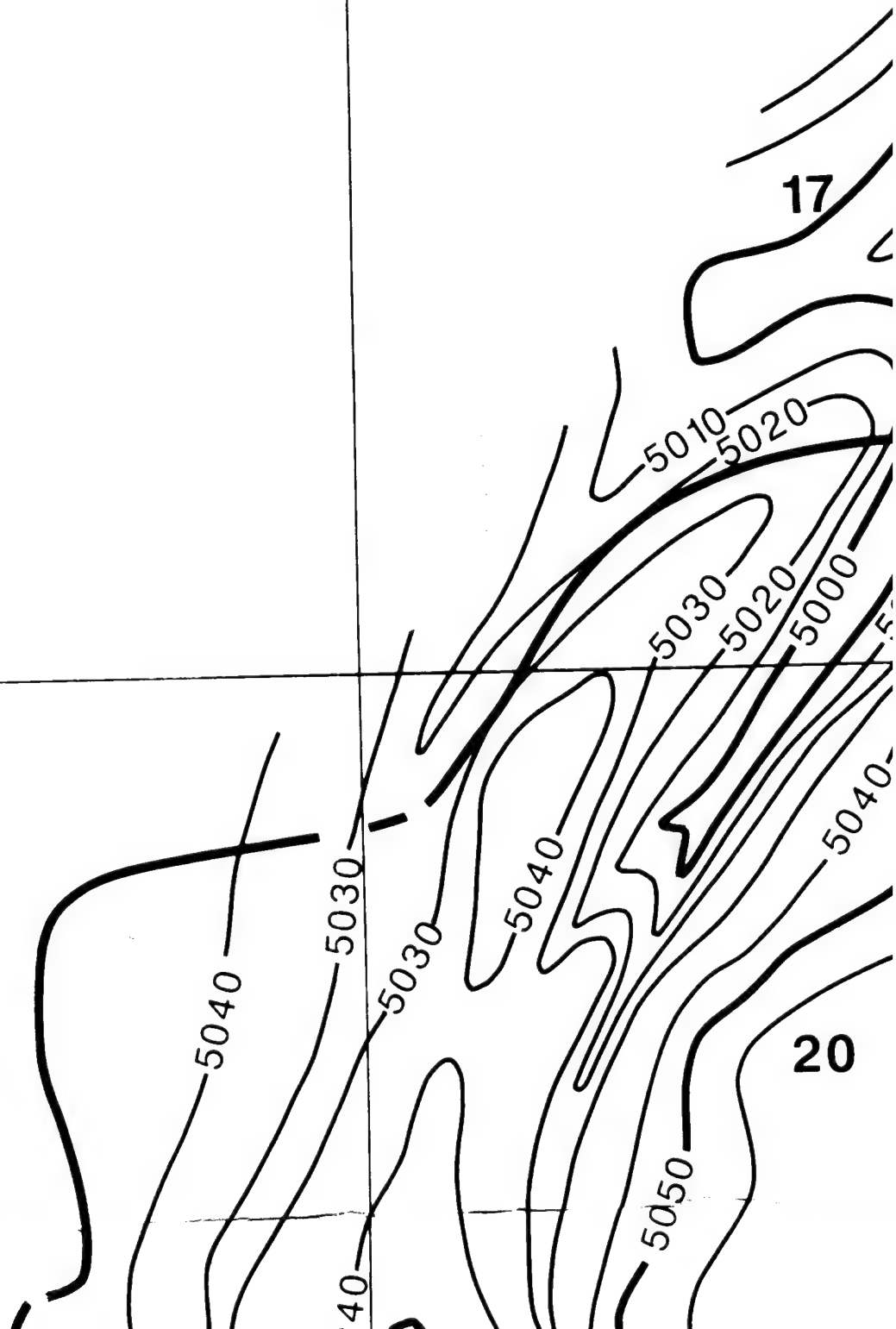
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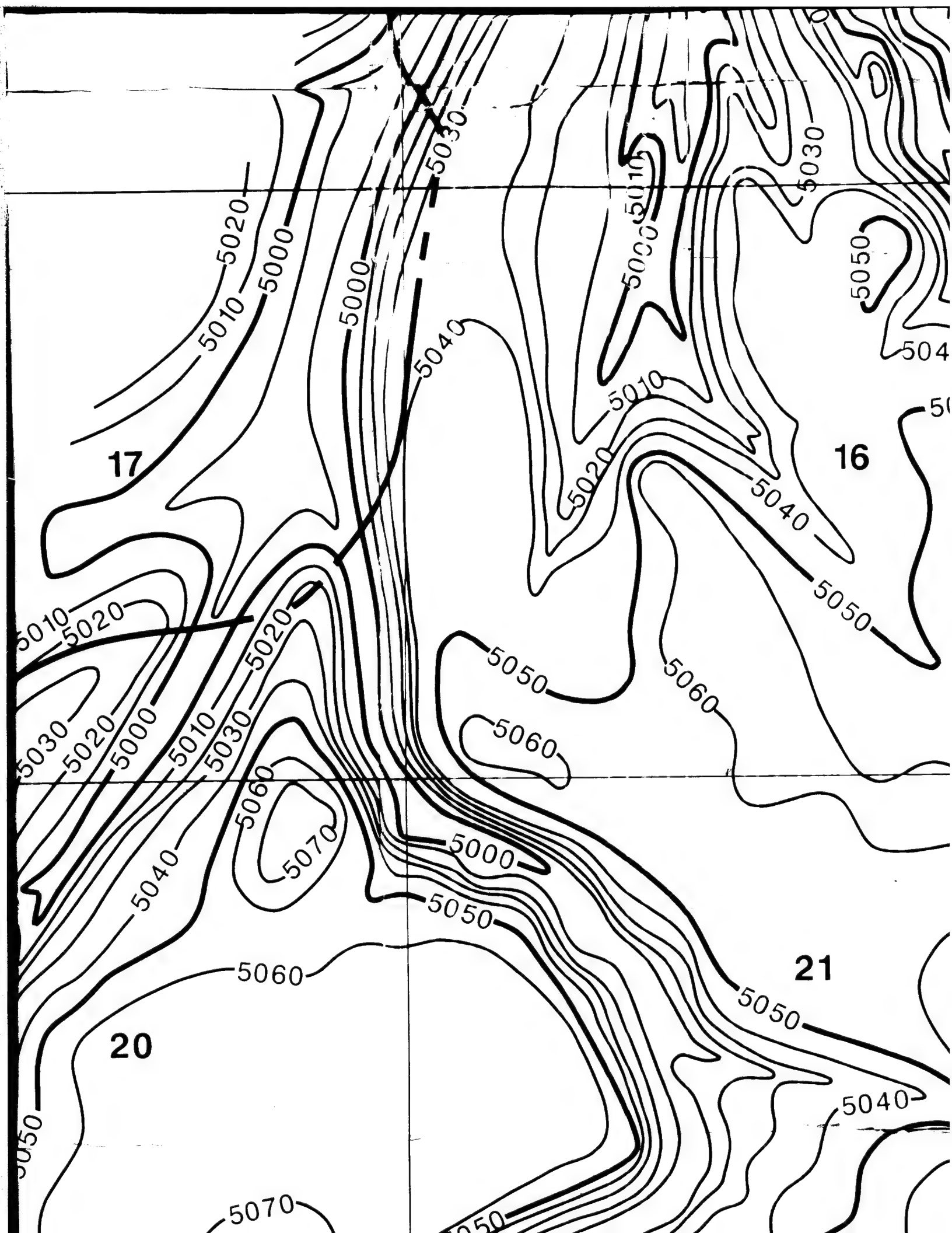
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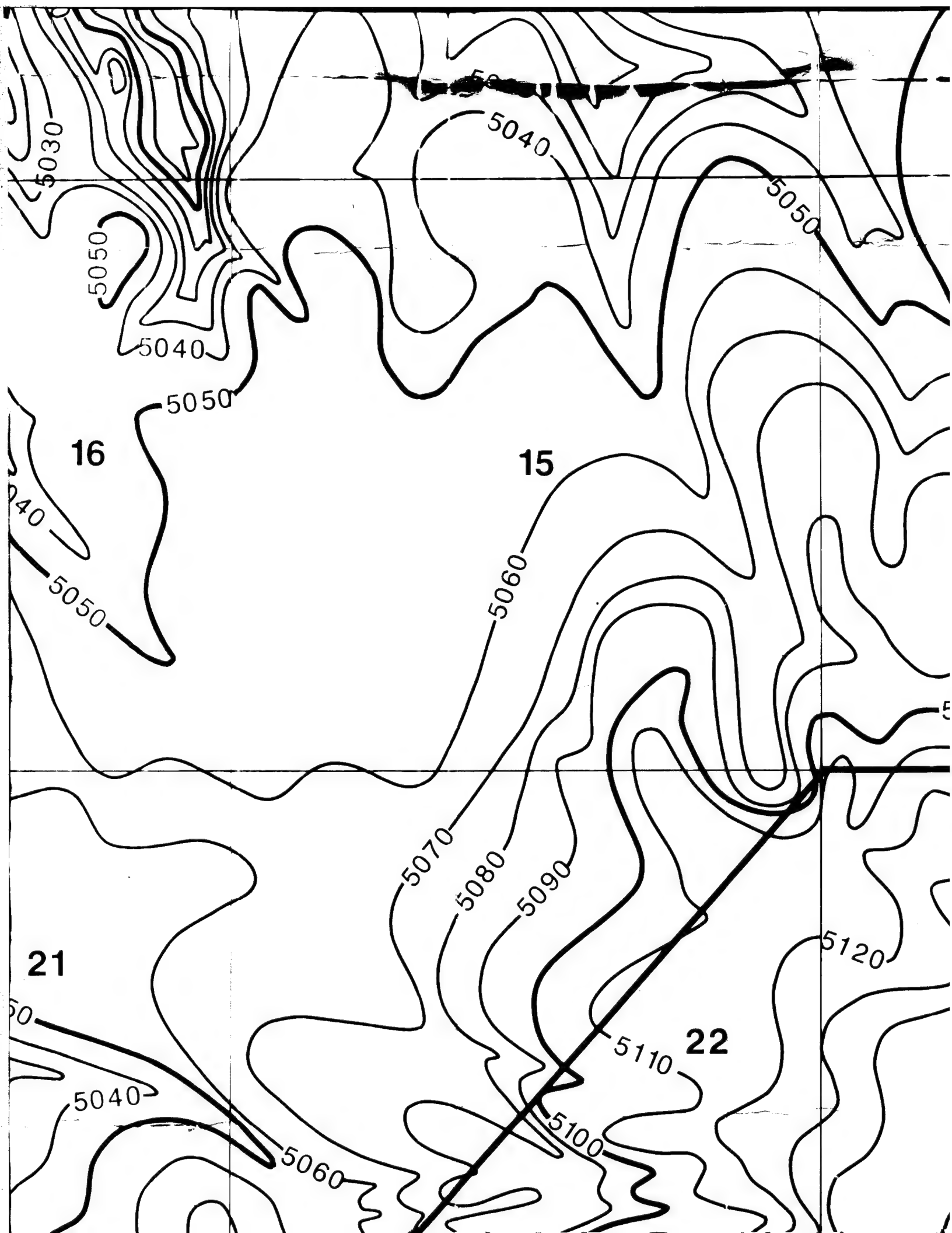
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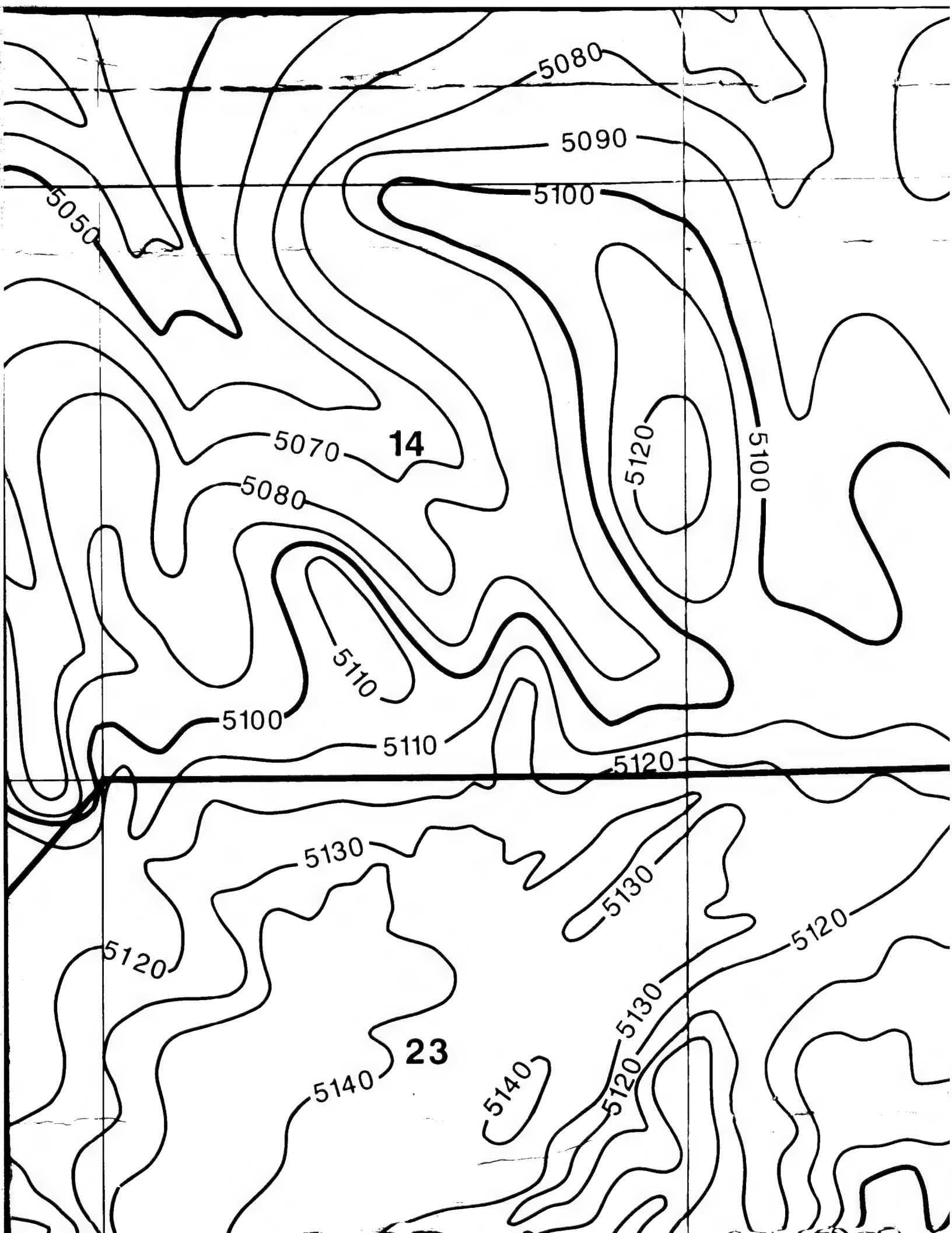
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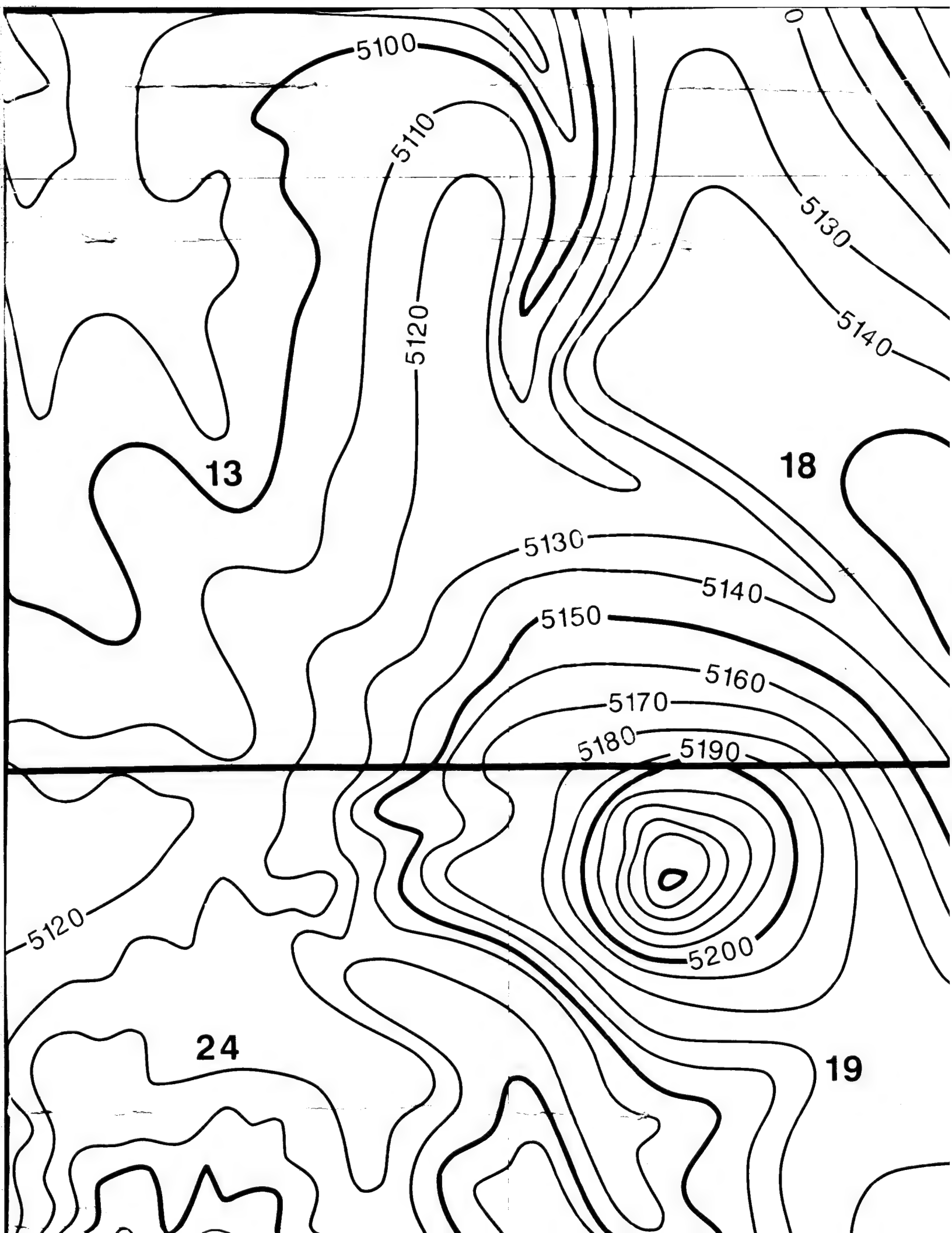


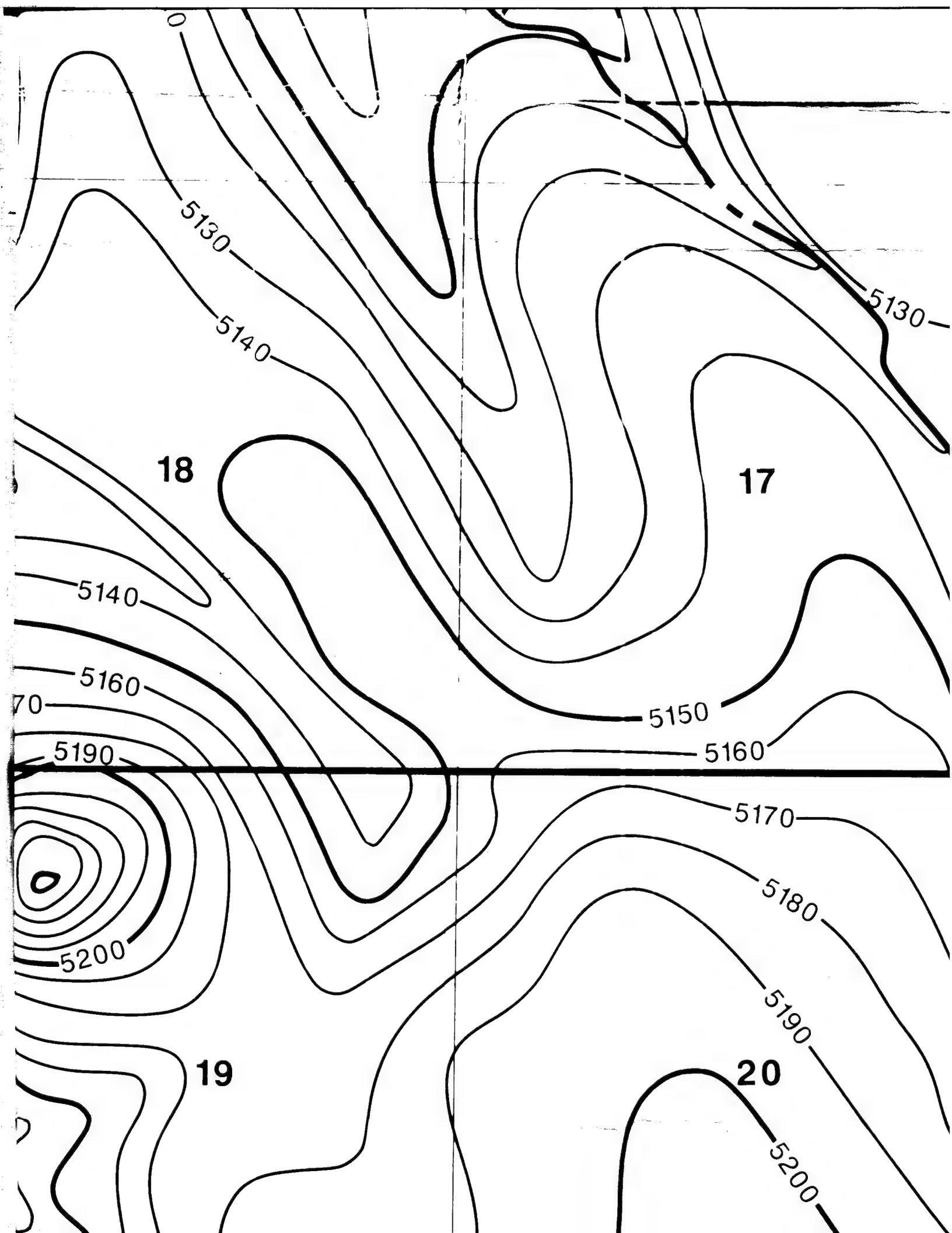


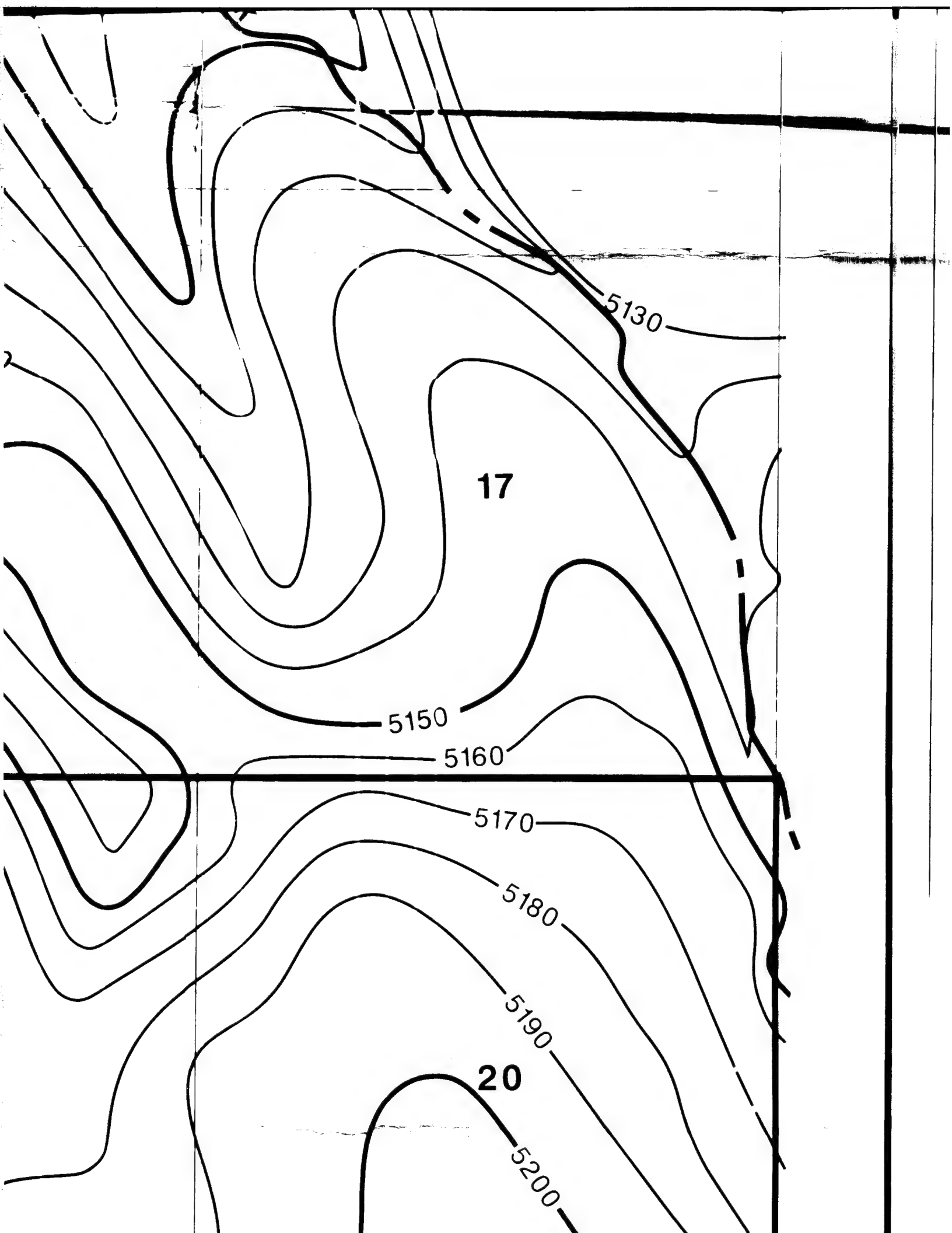












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5150

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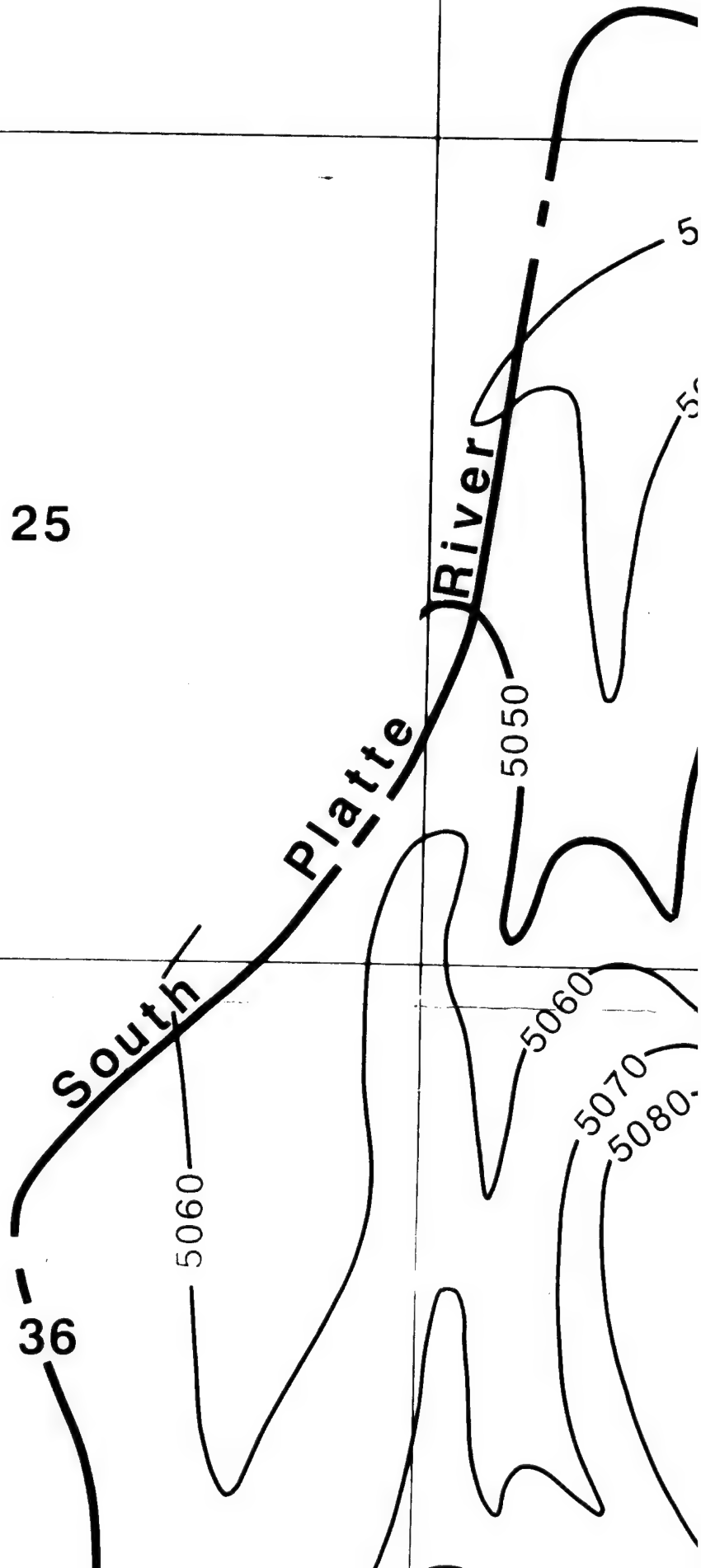
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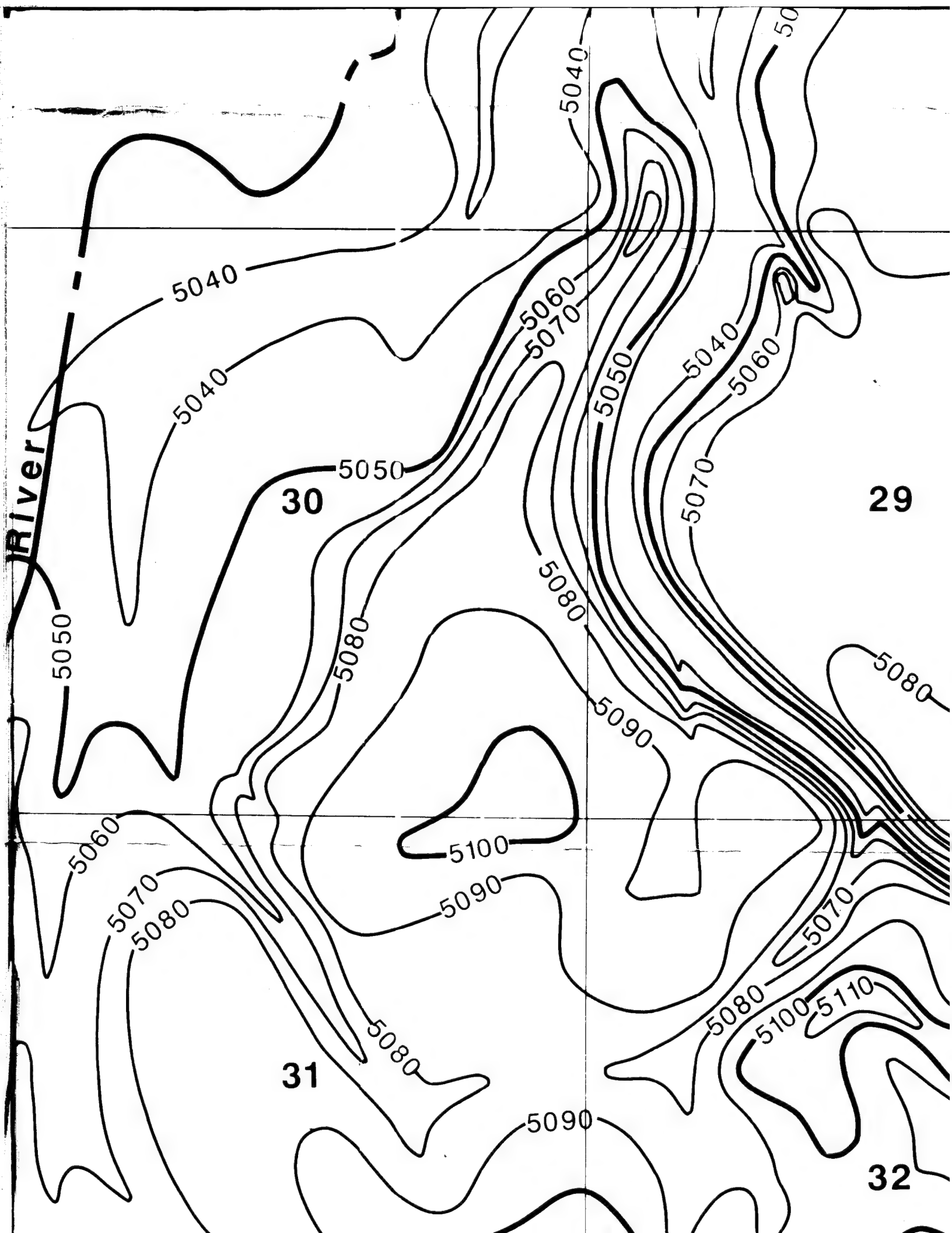
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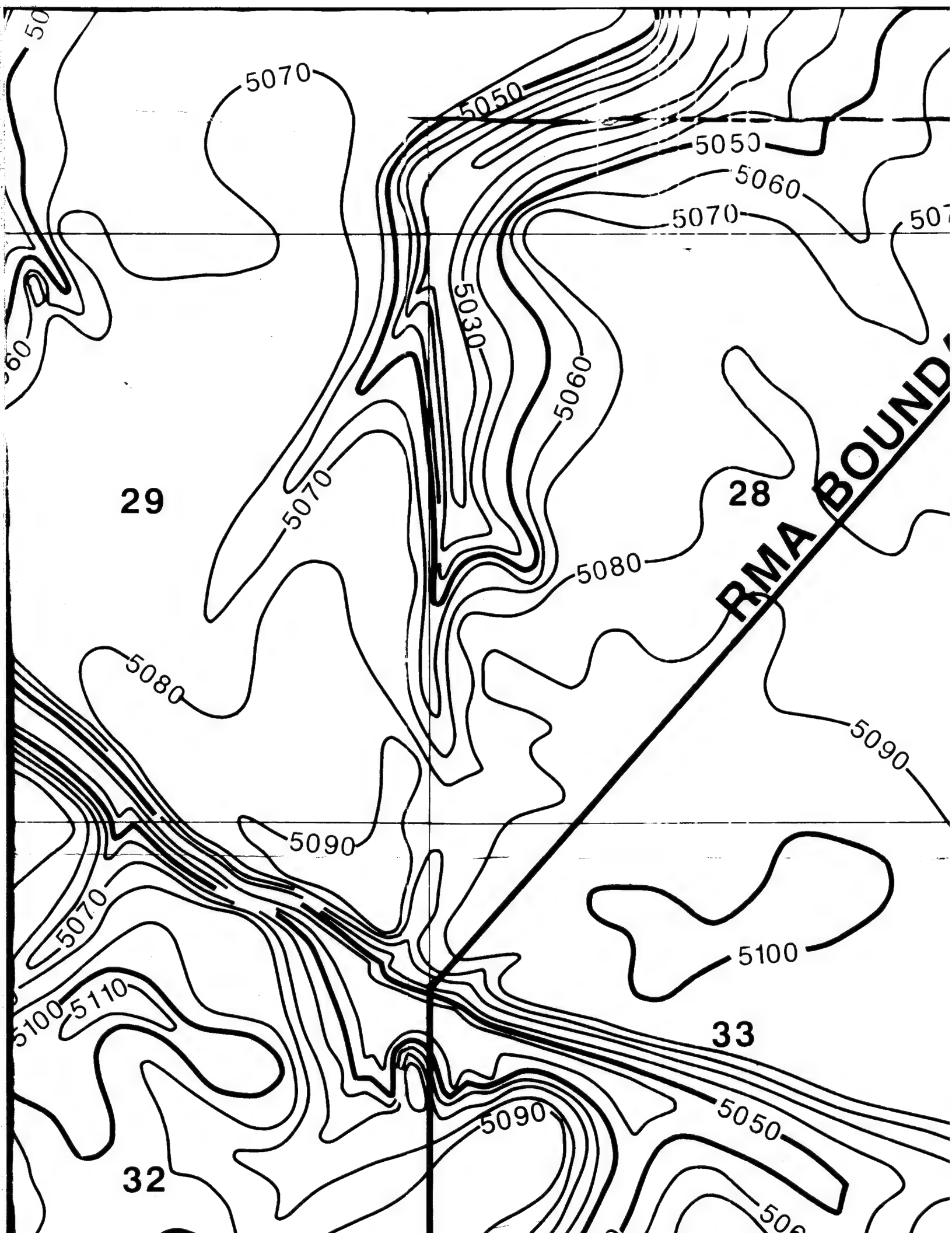
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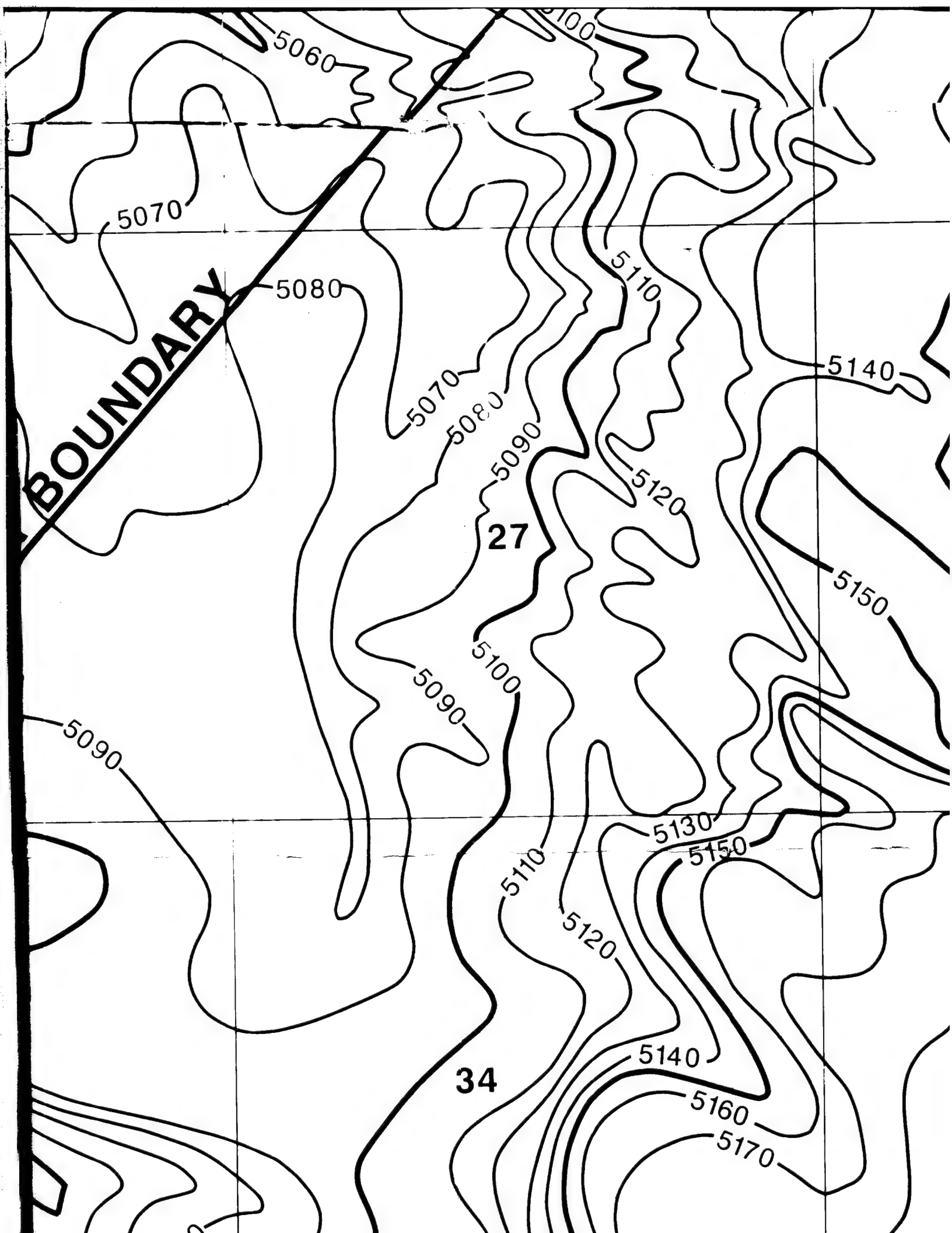
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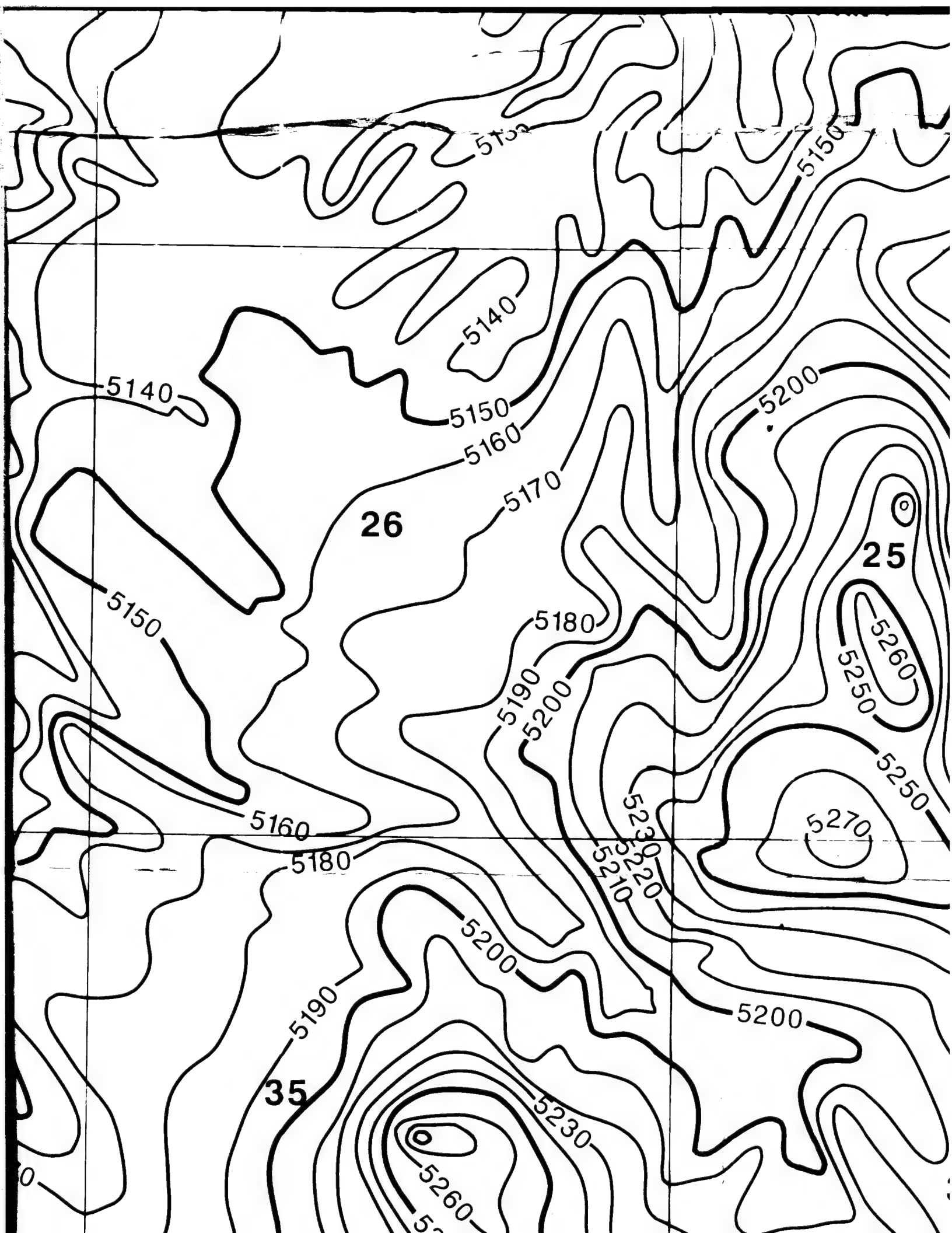
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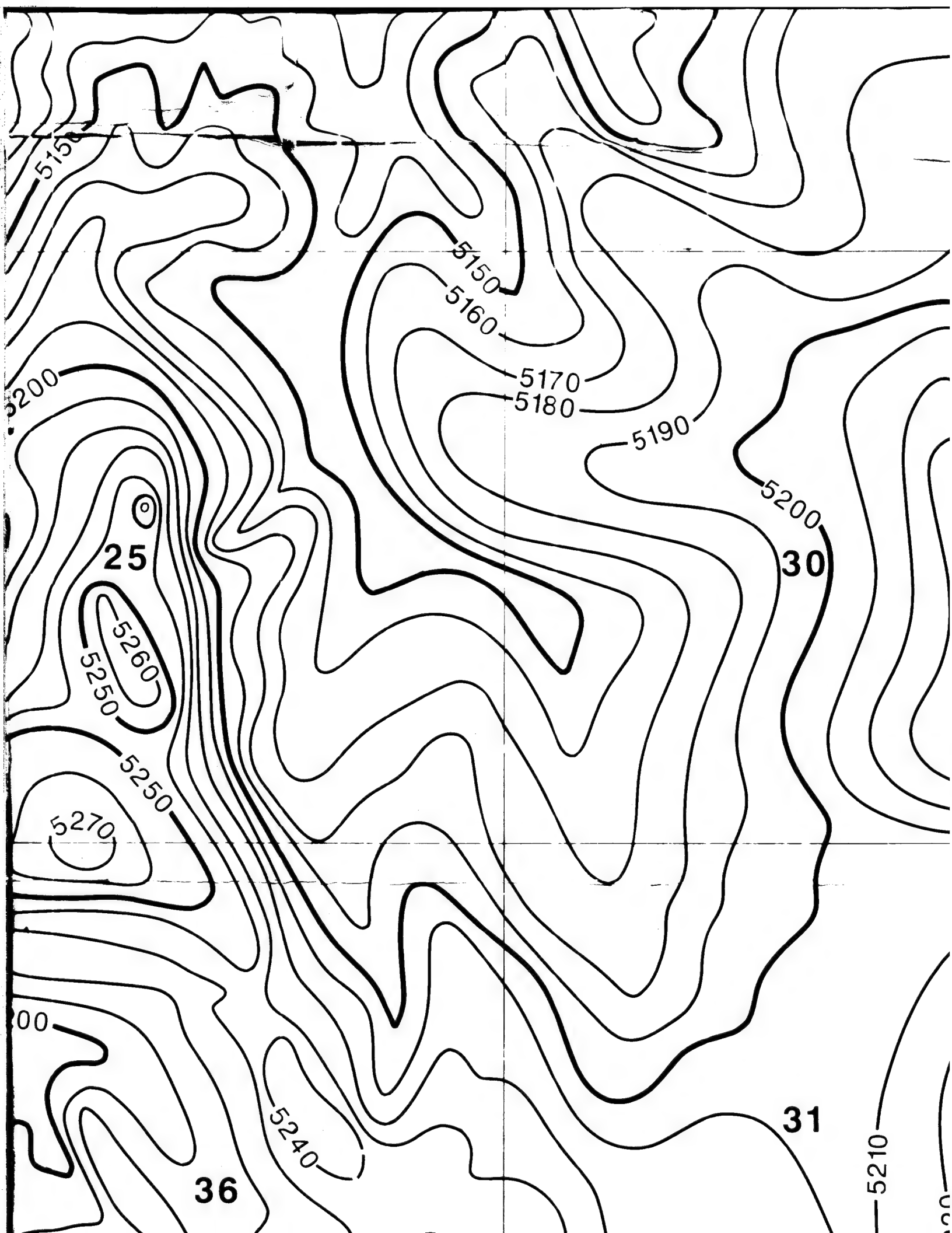












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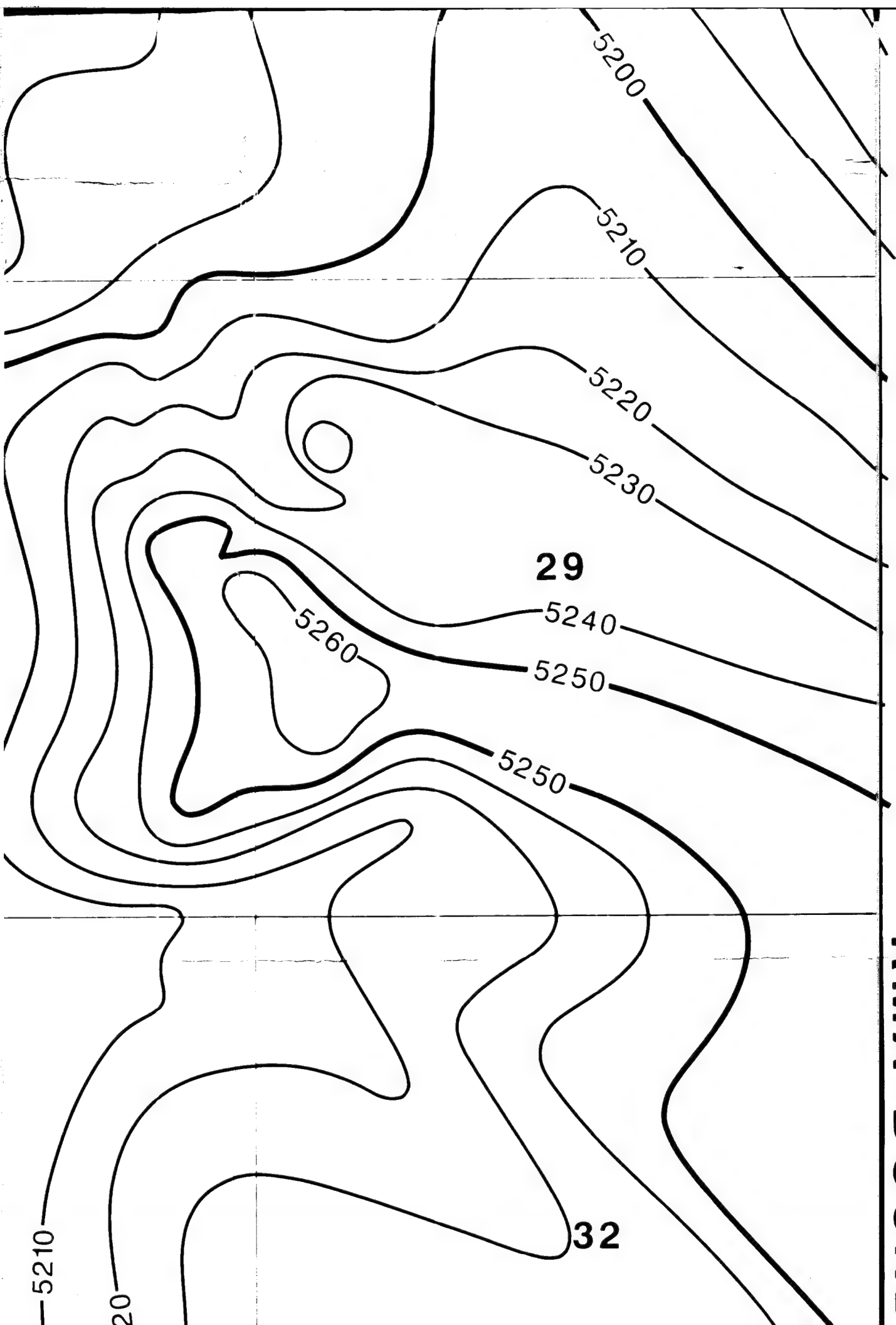
30

31

36

00

# RMA BOUND



T2S  
T3S

36

5070

5070

5080

1

5090

5090

5100

5100

5090  
5080

5080

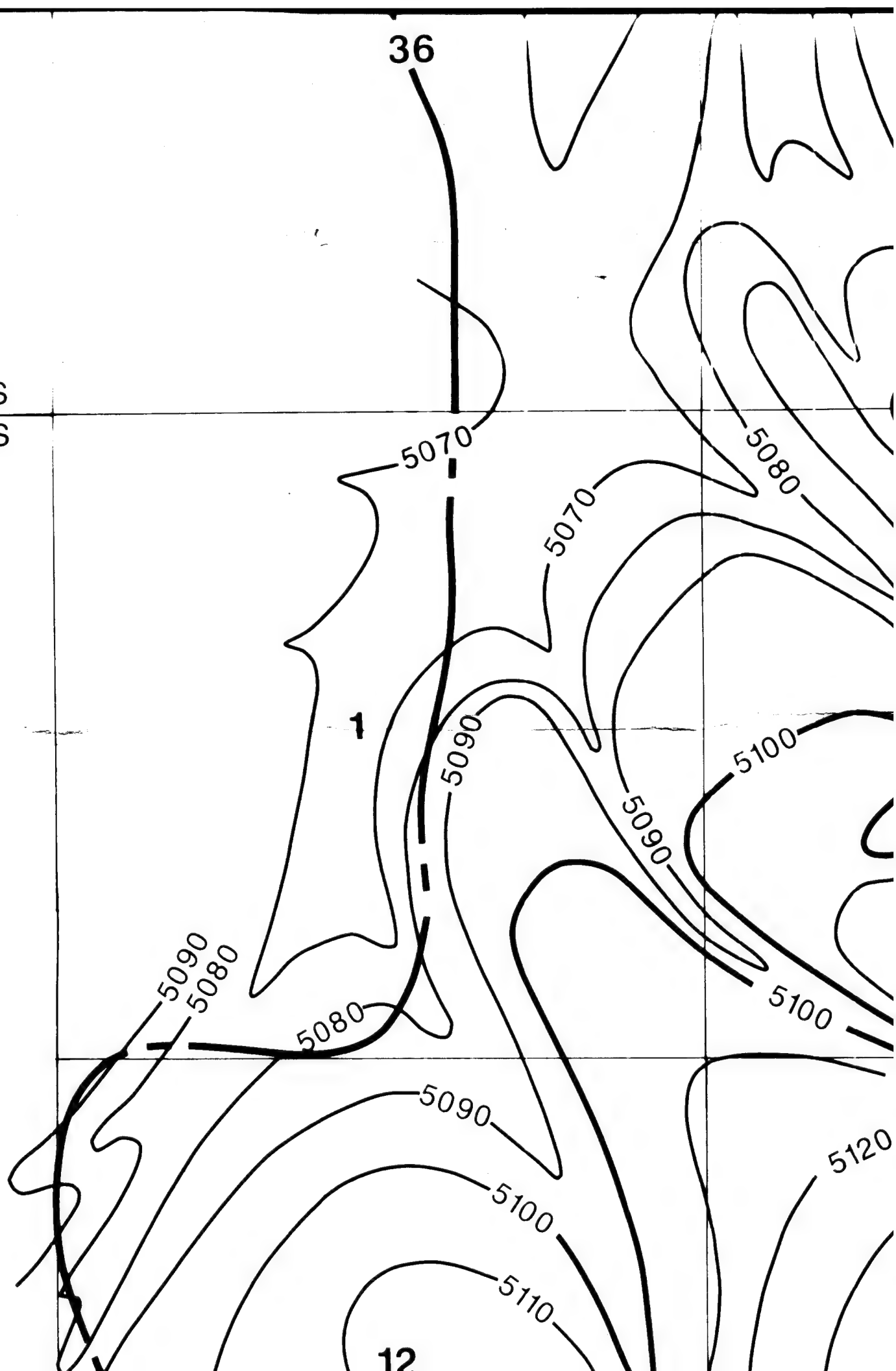
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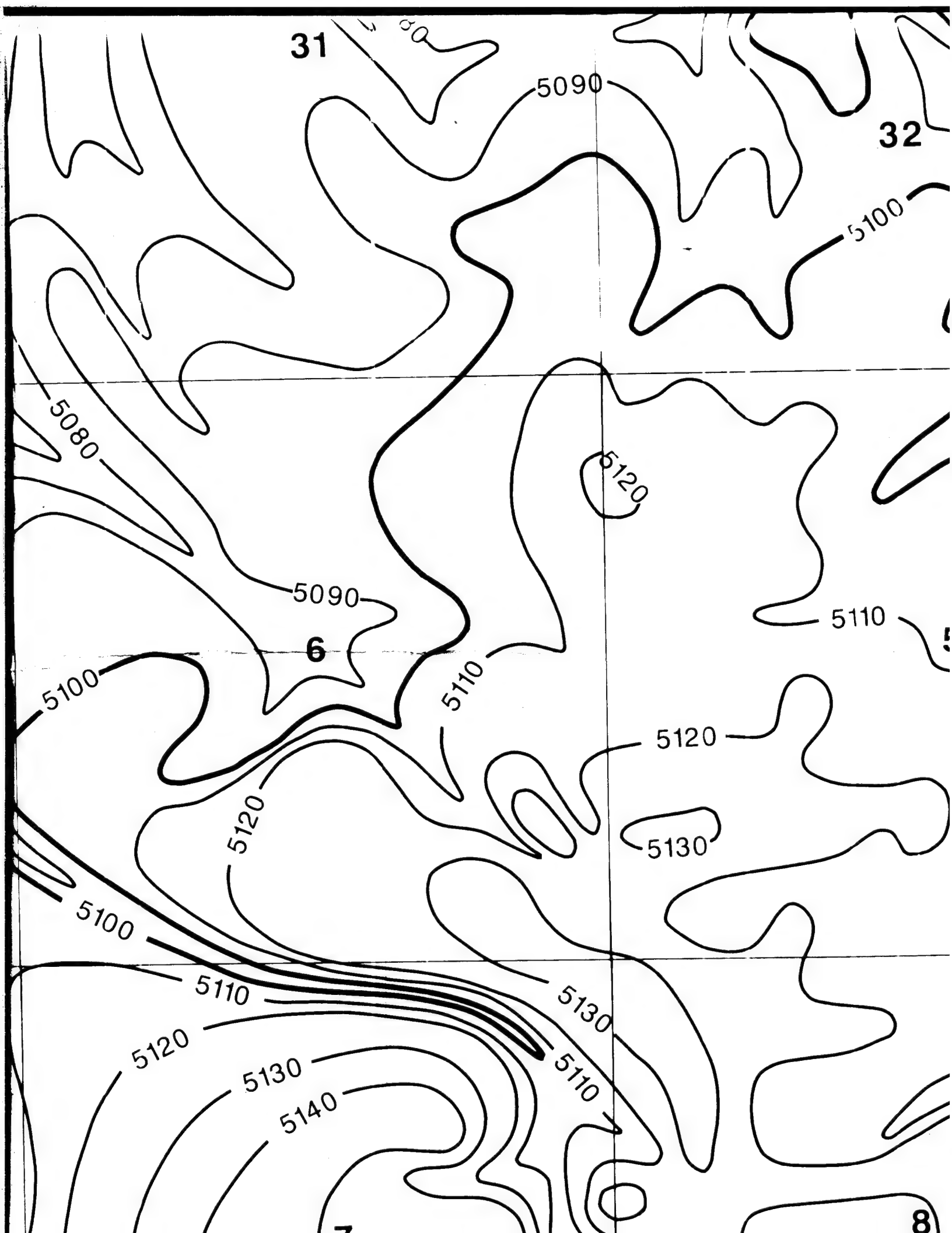
5100

5110

5120

12





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32

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5100

5080

5090

5120

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5100

5110

5120

5120

5130

5100

5110

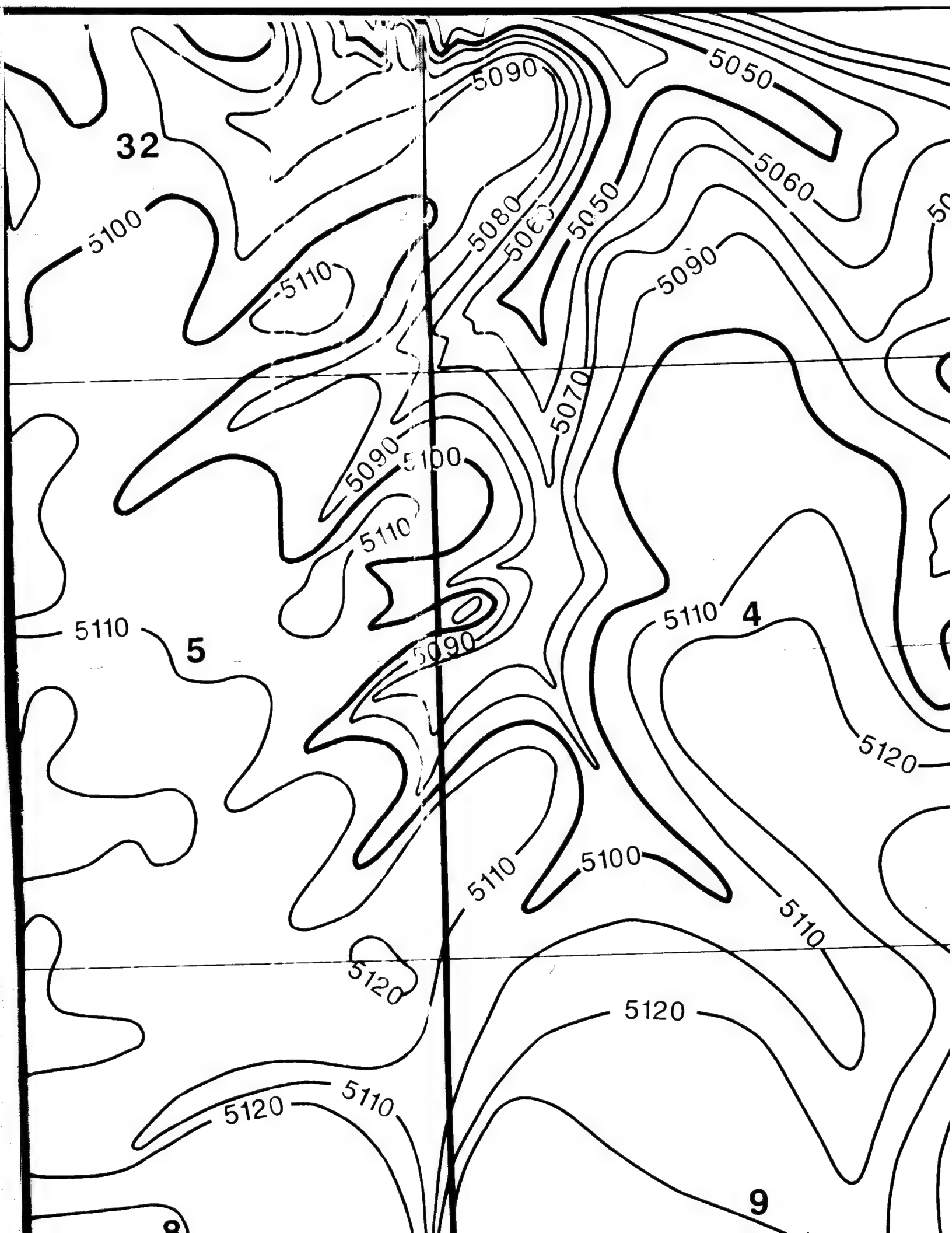
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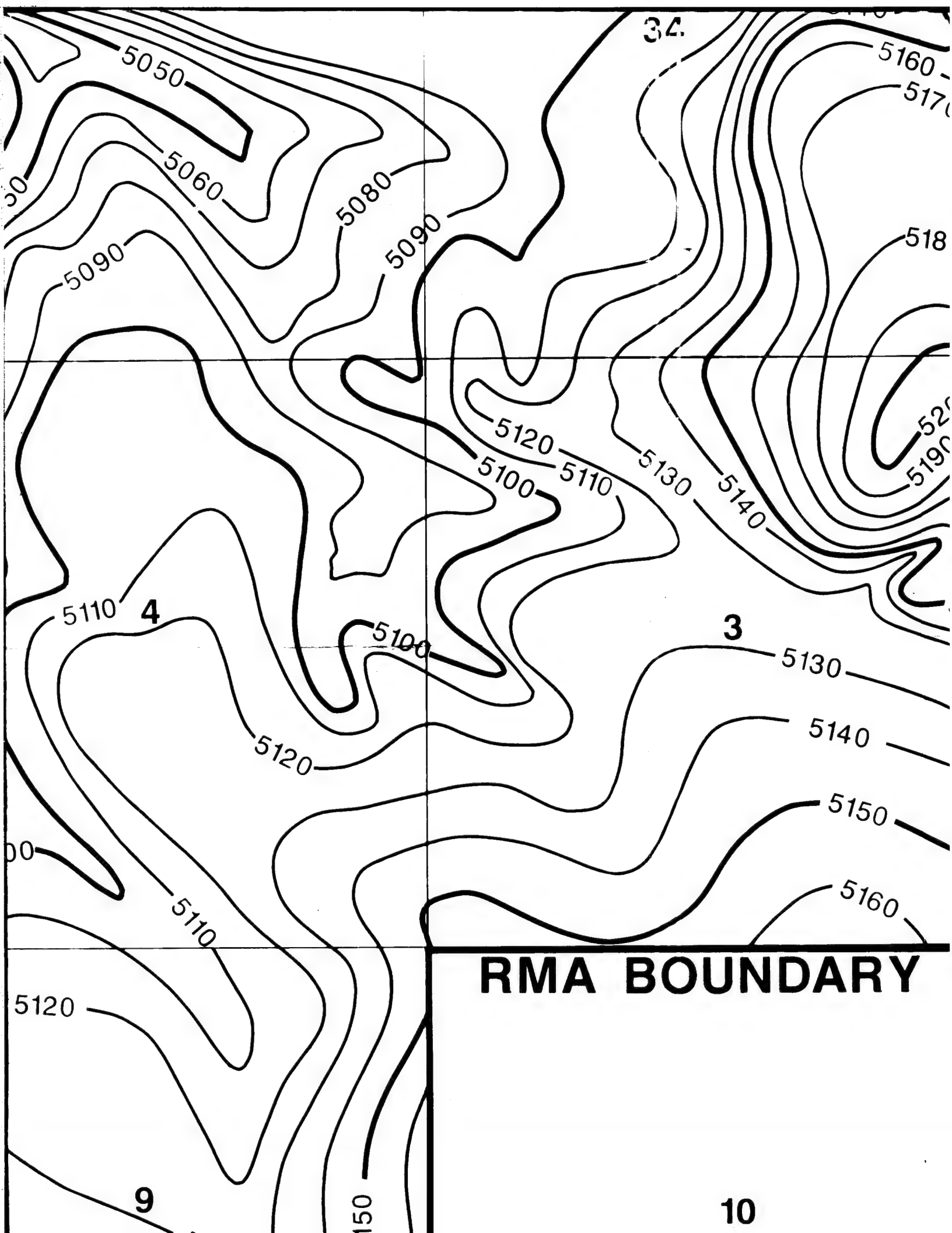
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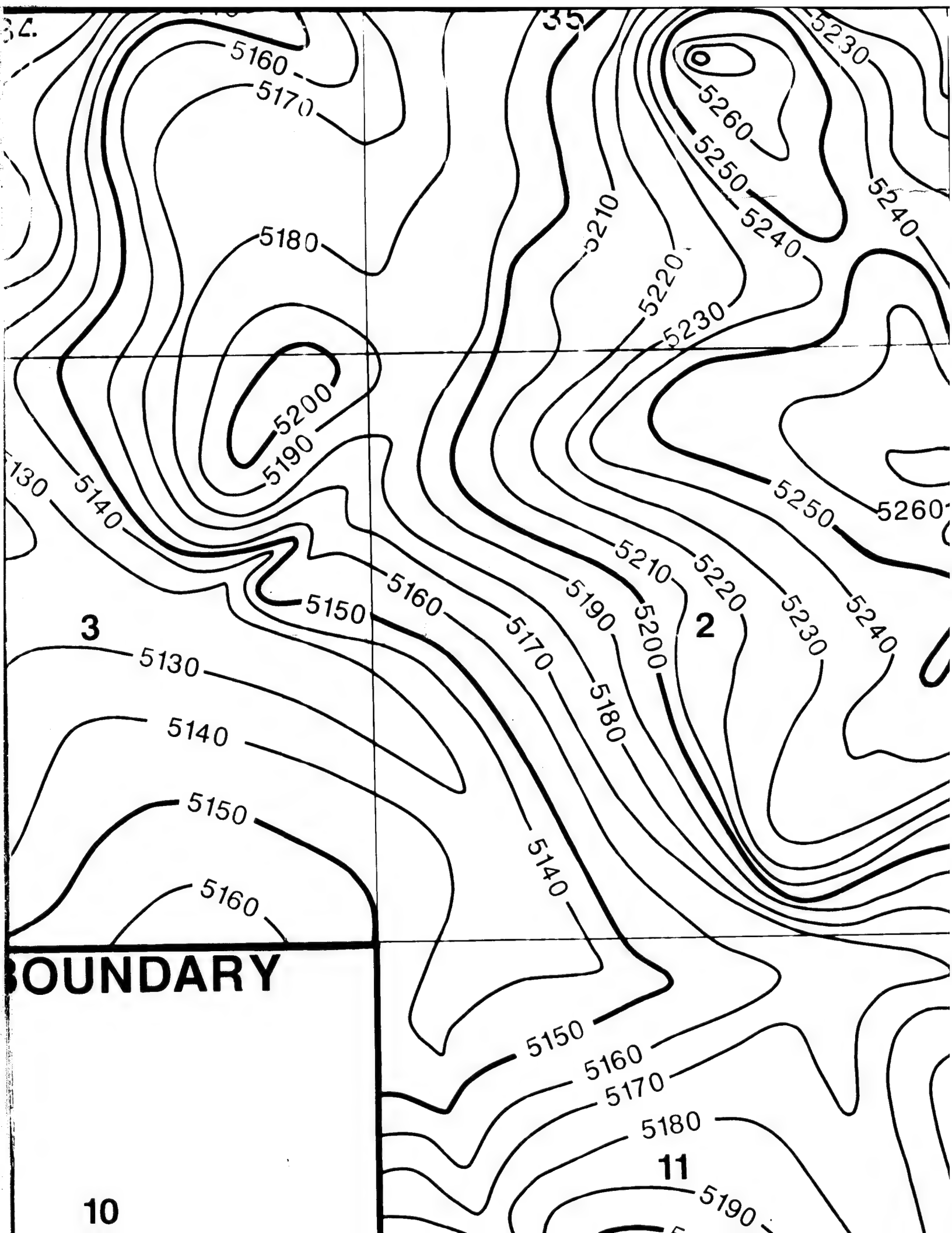
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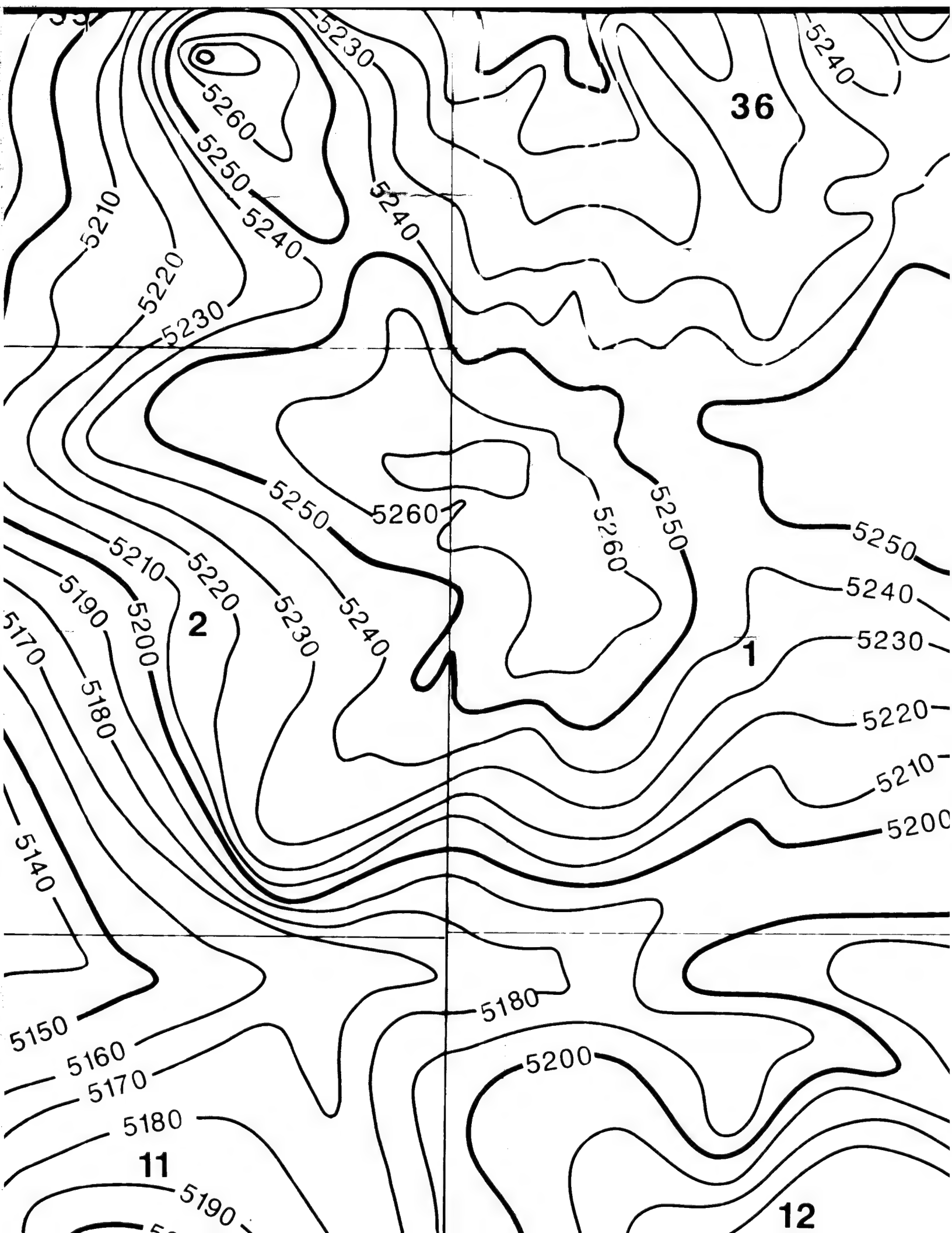


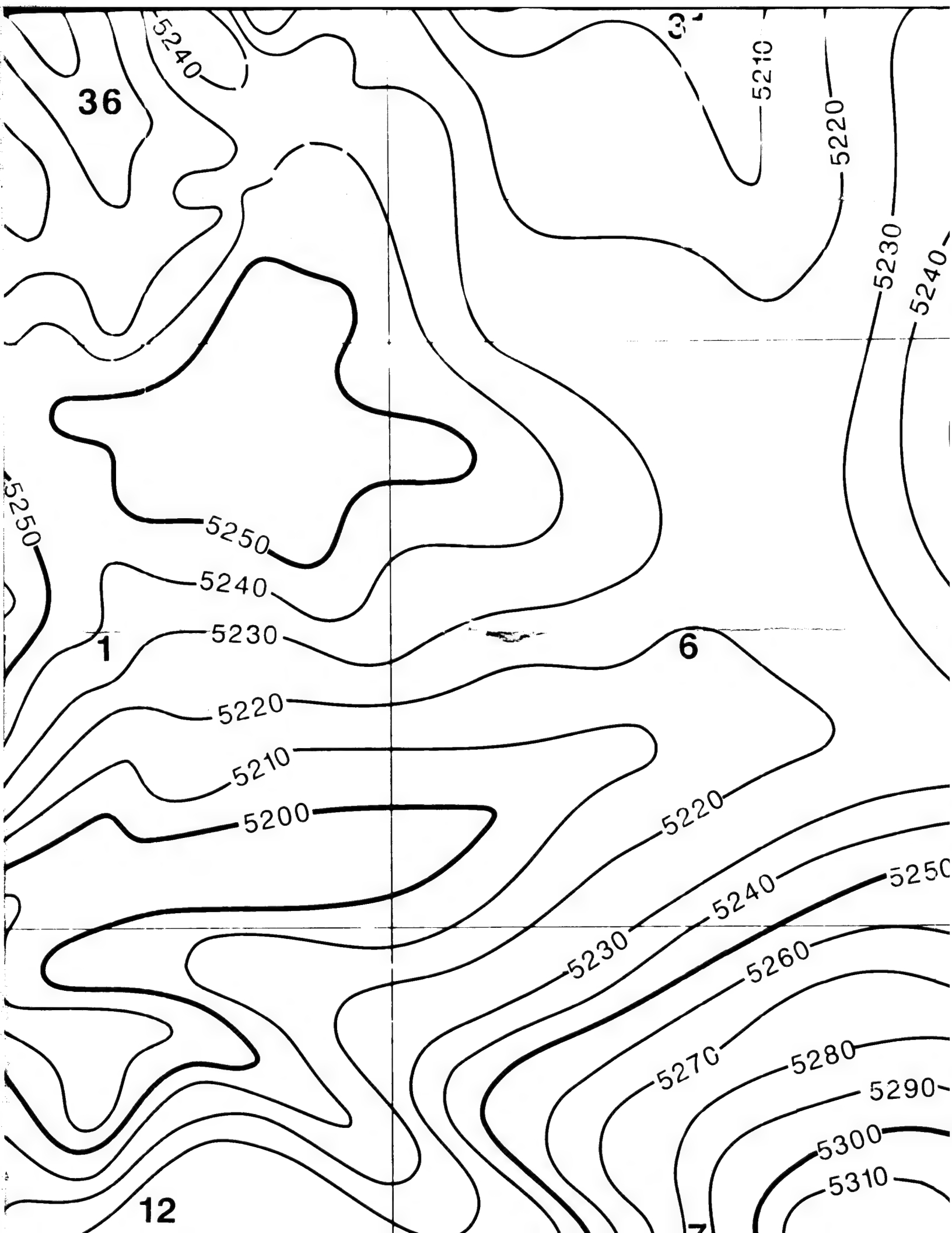


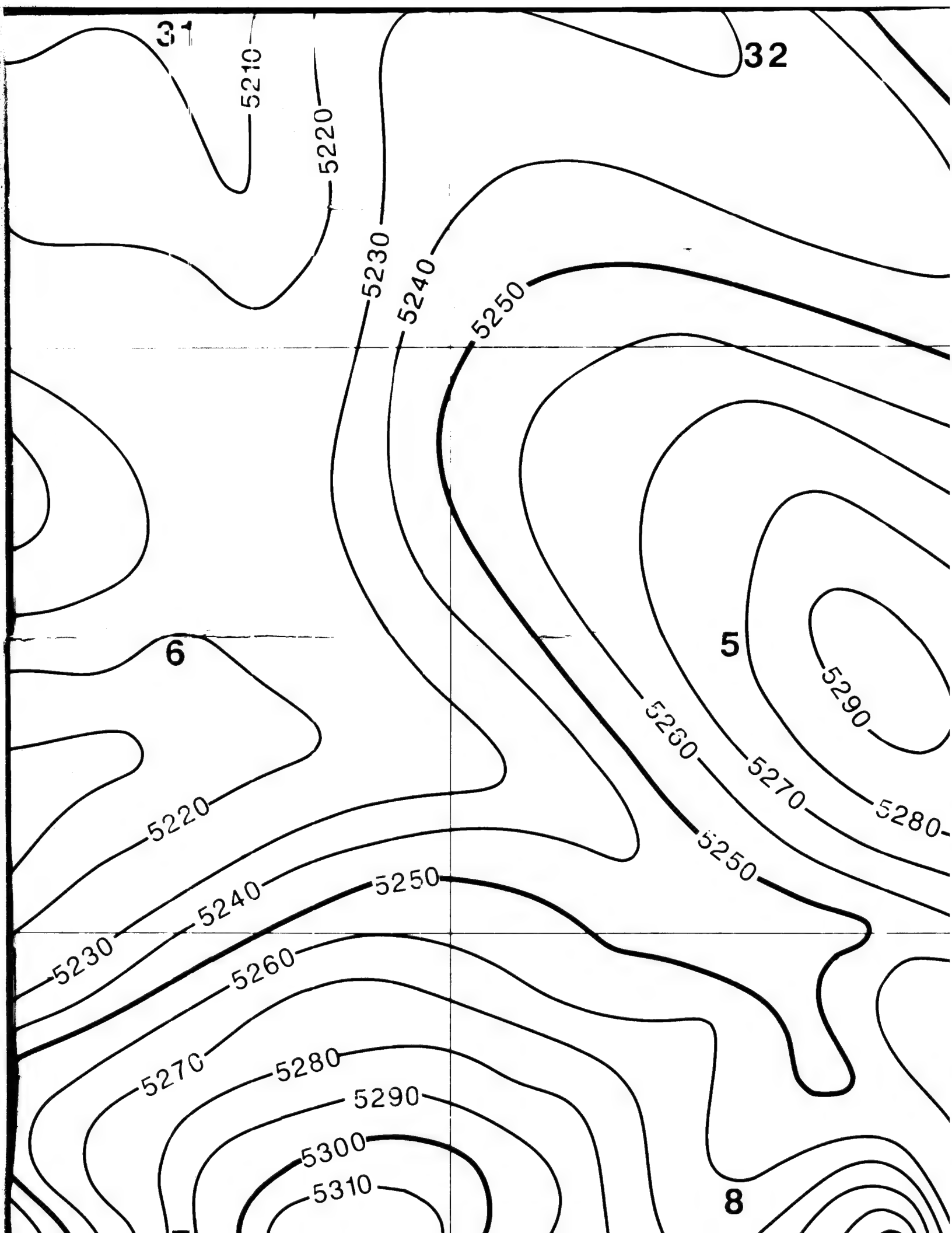












BOUNDARY

T2S

T3S

32

5220

5230

5240

5250

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5290

5300

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12

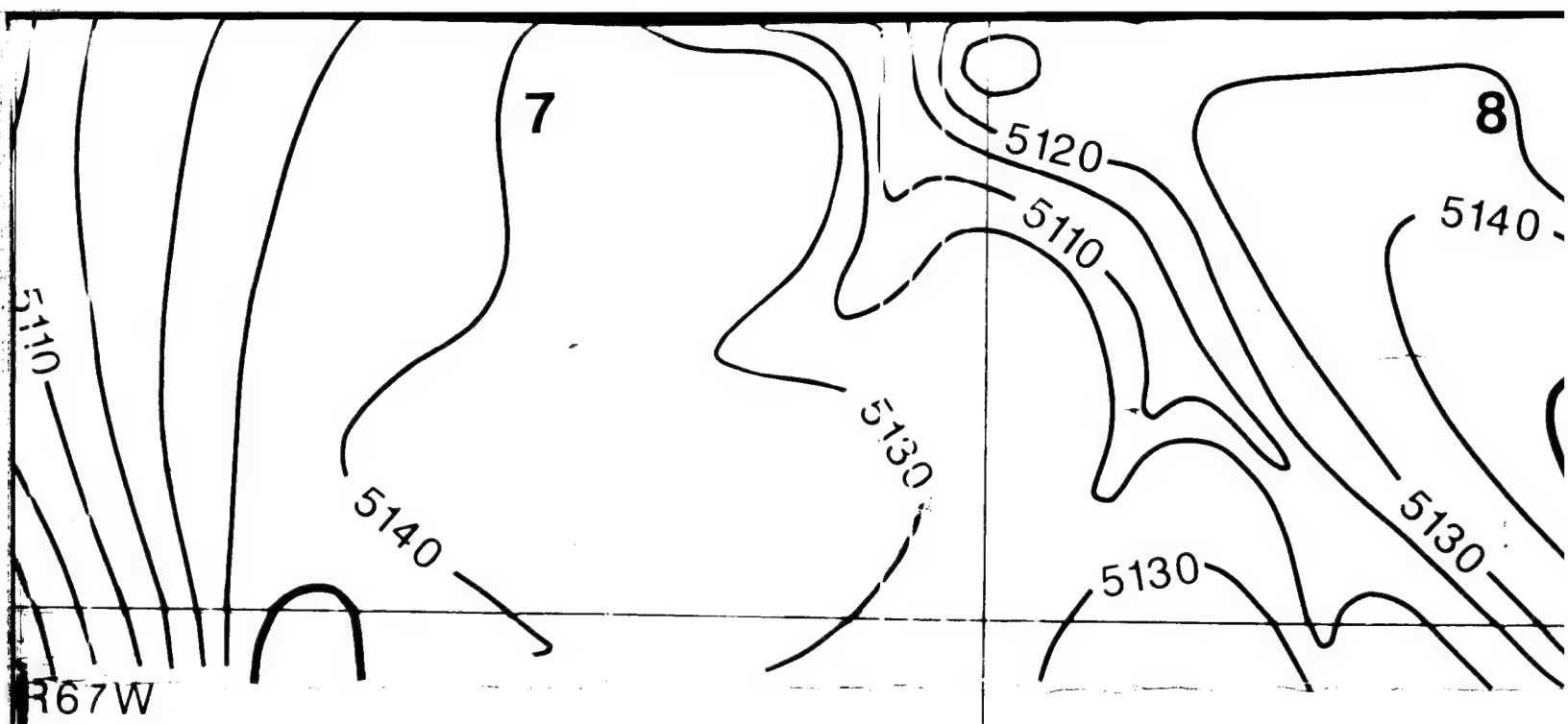
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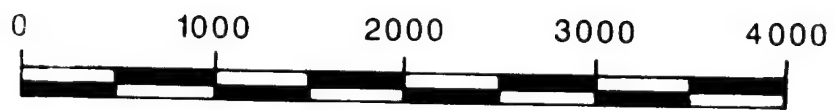
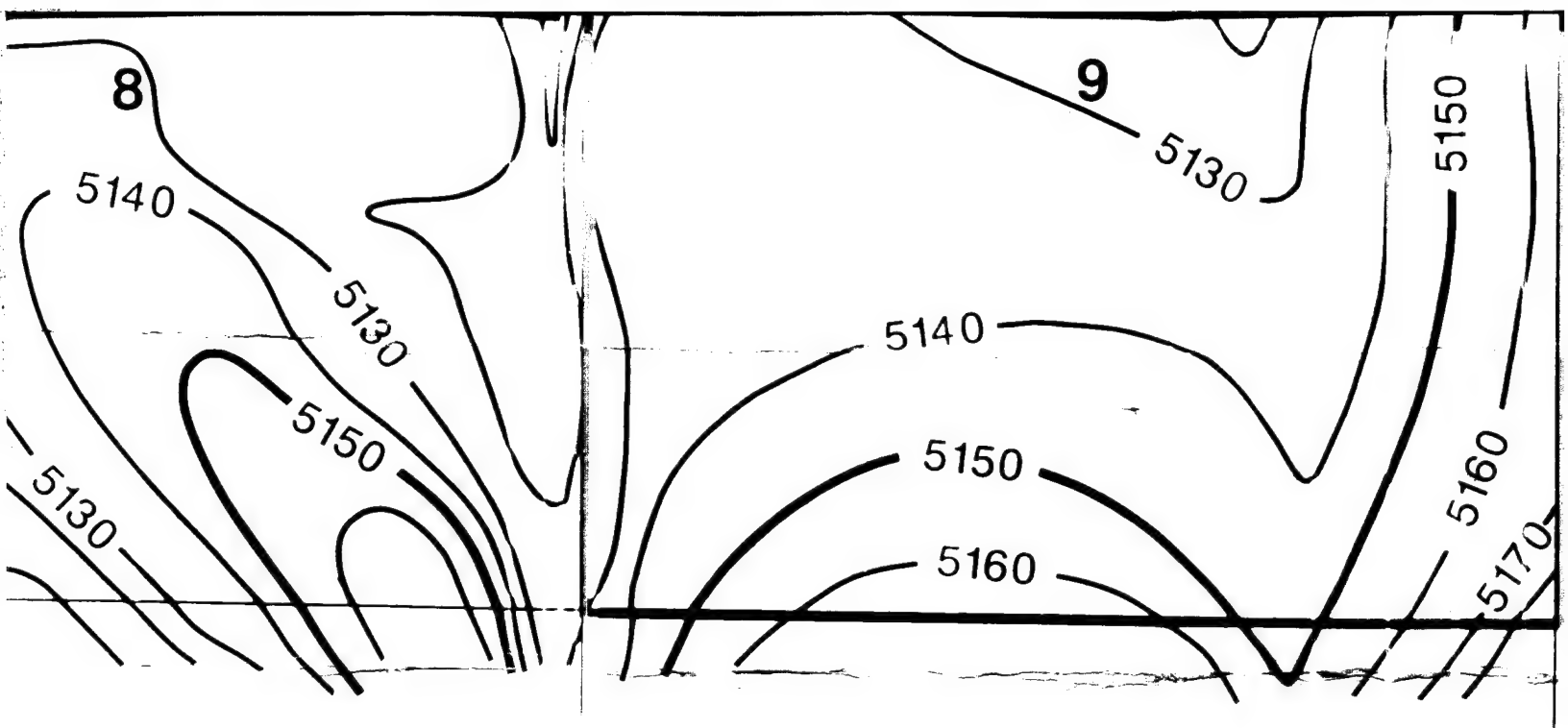
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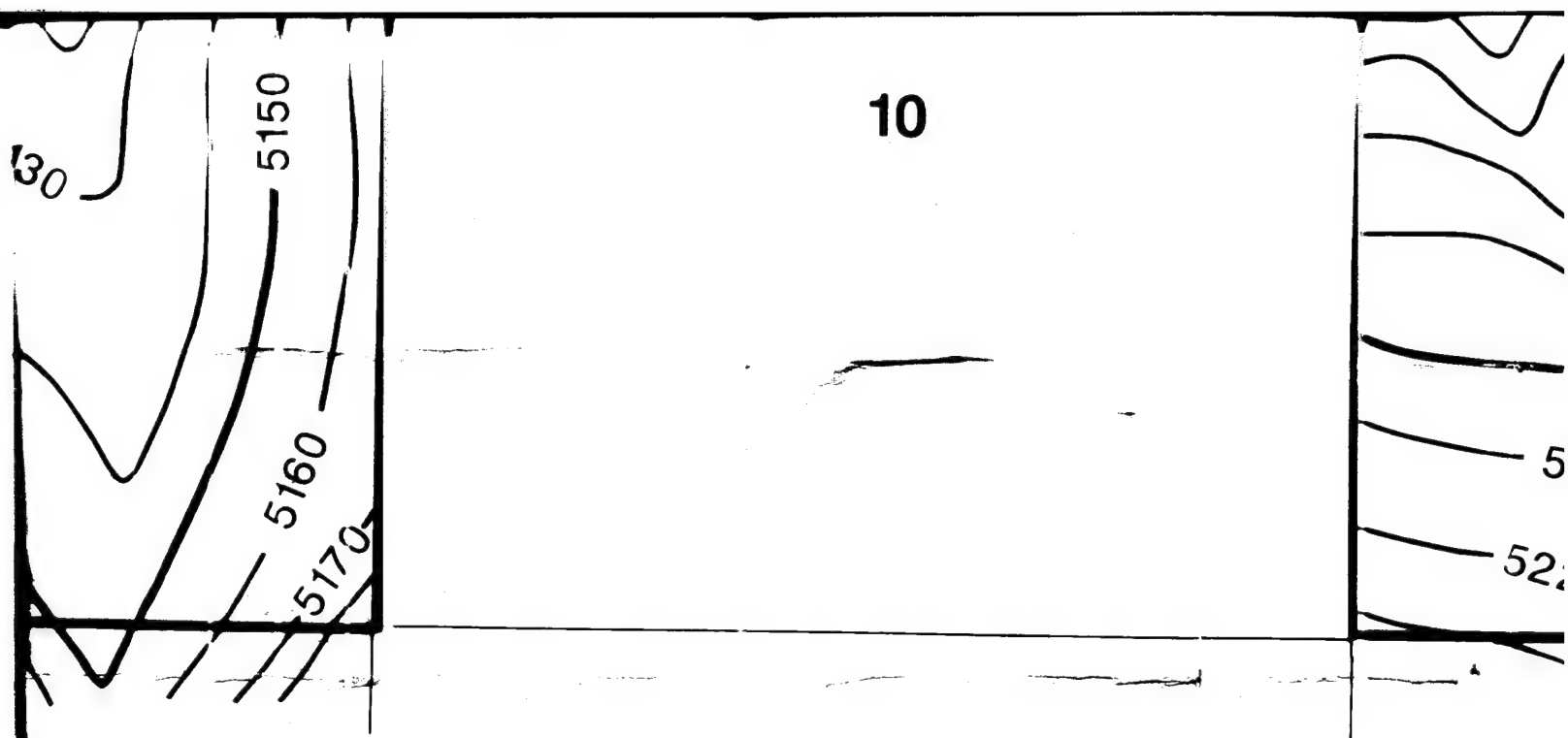
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168W R67W





Scale In Feet



**EXPLANATION**

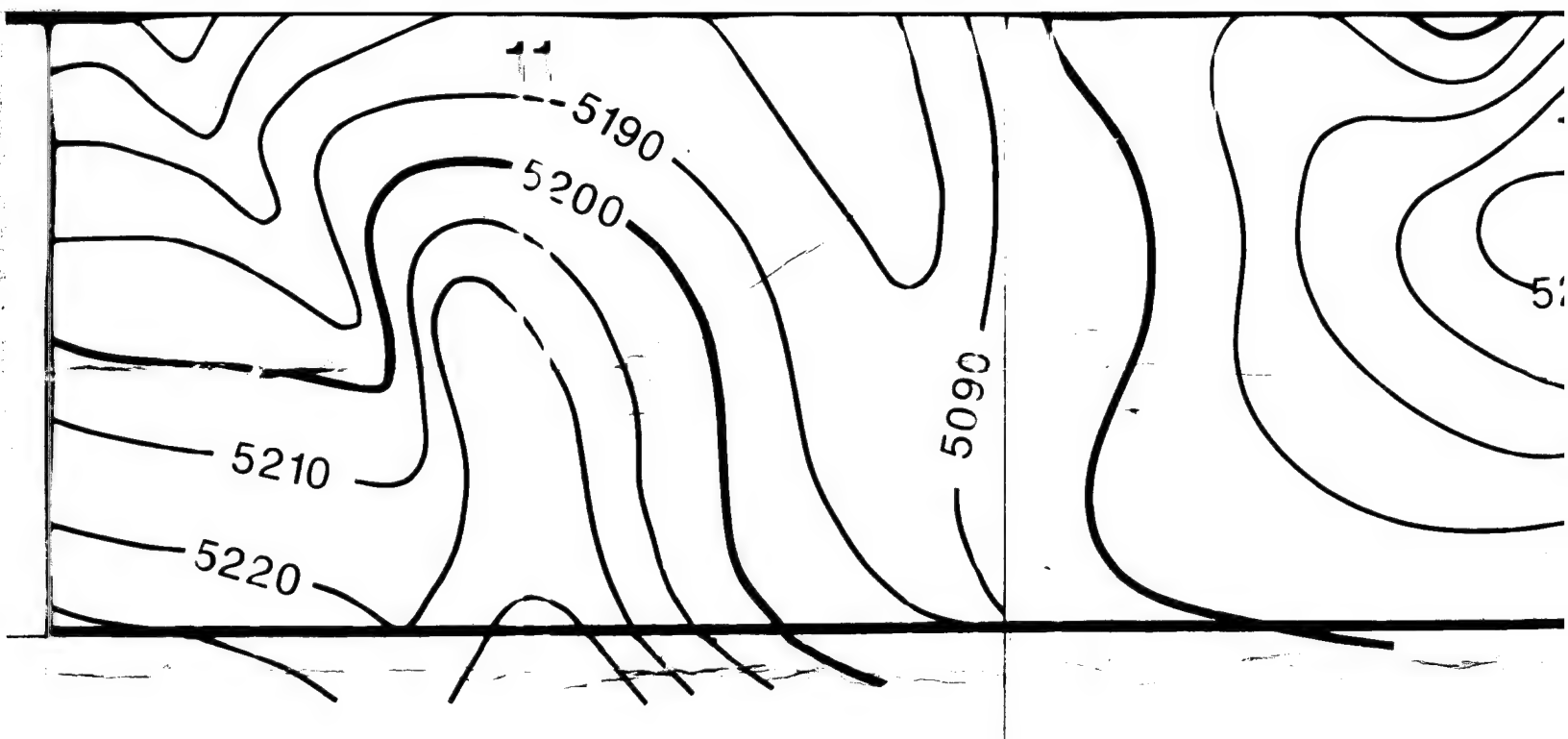
Contour Interval 10

Elevations In Feet

4000







# PLANATION

Contour Interval Equals Ten Feet

Elevations In Feet Above Mean Sea Level

12

5240

5300

5310

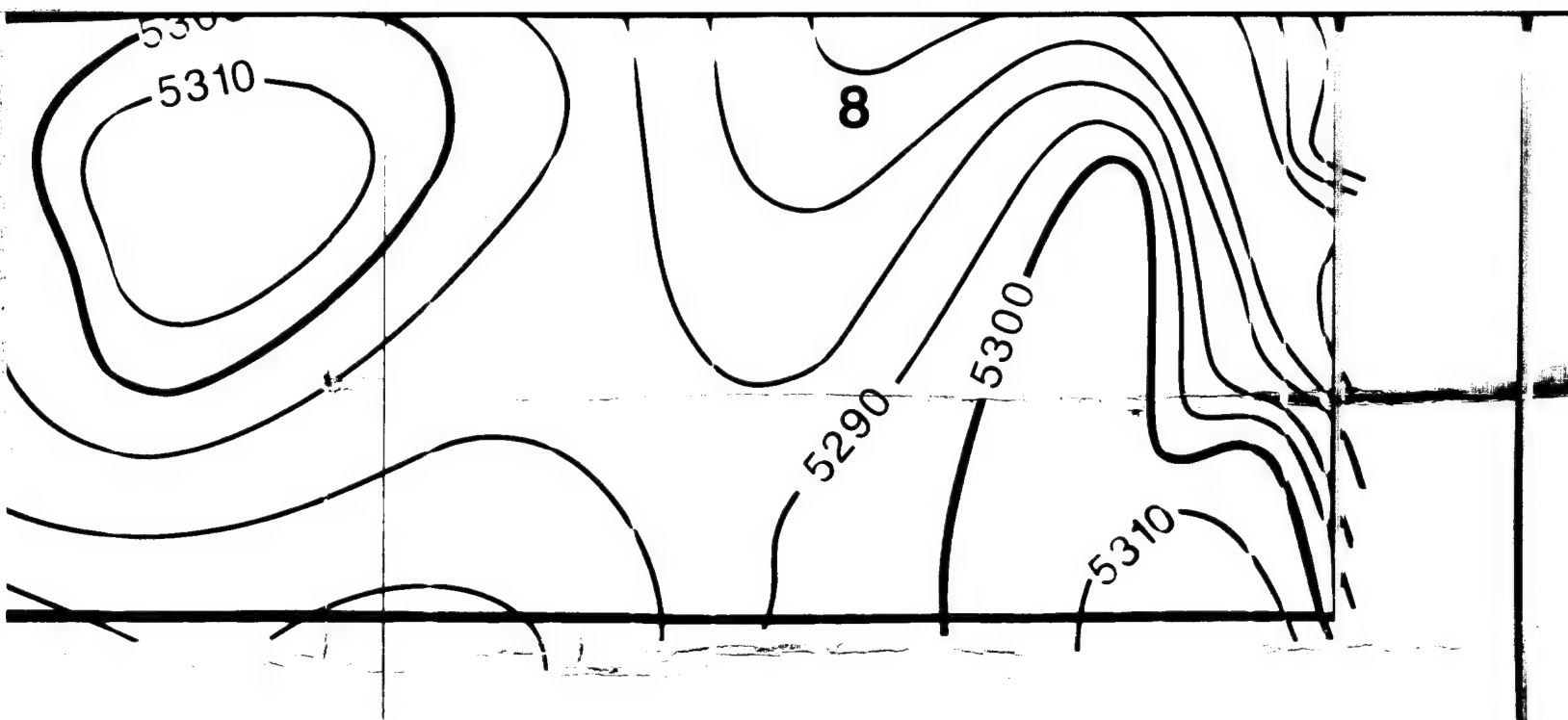
7

R67W | R66W

PI  
DRAWING

ESE PRO

DRAWN R



# RMA BEDROCK ELEVATION CONTOUR MAP

Plate 3

DRAWING NO. DRAWING TITLE

ESE PROJECT NUMBER SCALE

1" = 1000'

**ESE** ENVIRONMENTAL SCIENCE  
AND ENGINEERING, INC.  
AN RMI COMPANY

DRAWN REVISED BY CHK'D DATE

AT Jr. MJR

APPROVED FOR ISSUE BY

4/88  
DATE

9

10

37355 X

37363 X

37351 X

16

15

37354 X

37353 X

37350 X

10

11

37352 X

37349 X

37351 X

37348 X

37347 X

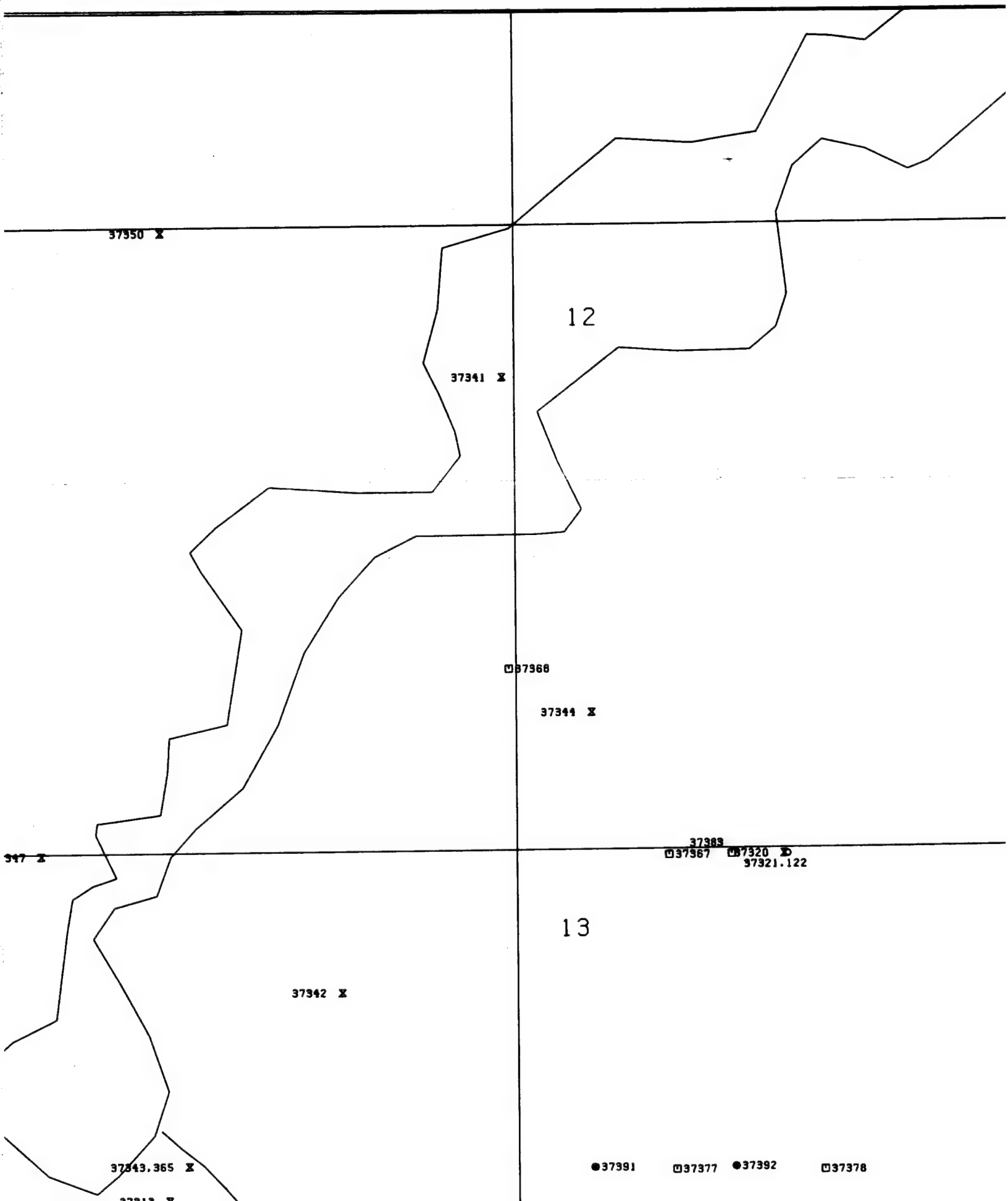
15

14

37346 X

37343, 365 X

37313 X



37350 X

12

37341 X

37368

37344 X

37383

37367

37320 X

37321.122

37342 X

37343.365 X

37312 X

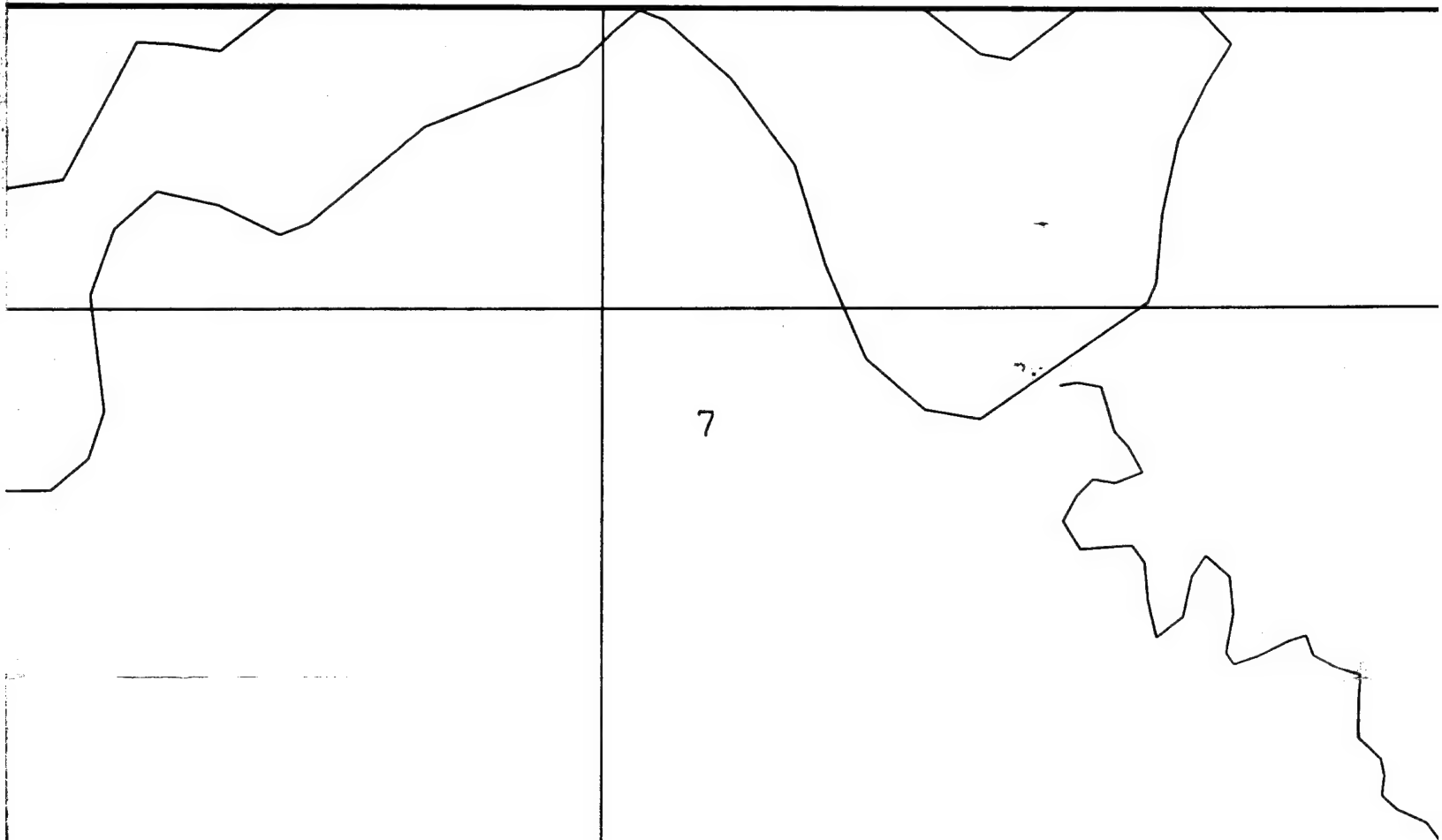
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37392

37378



37340 2

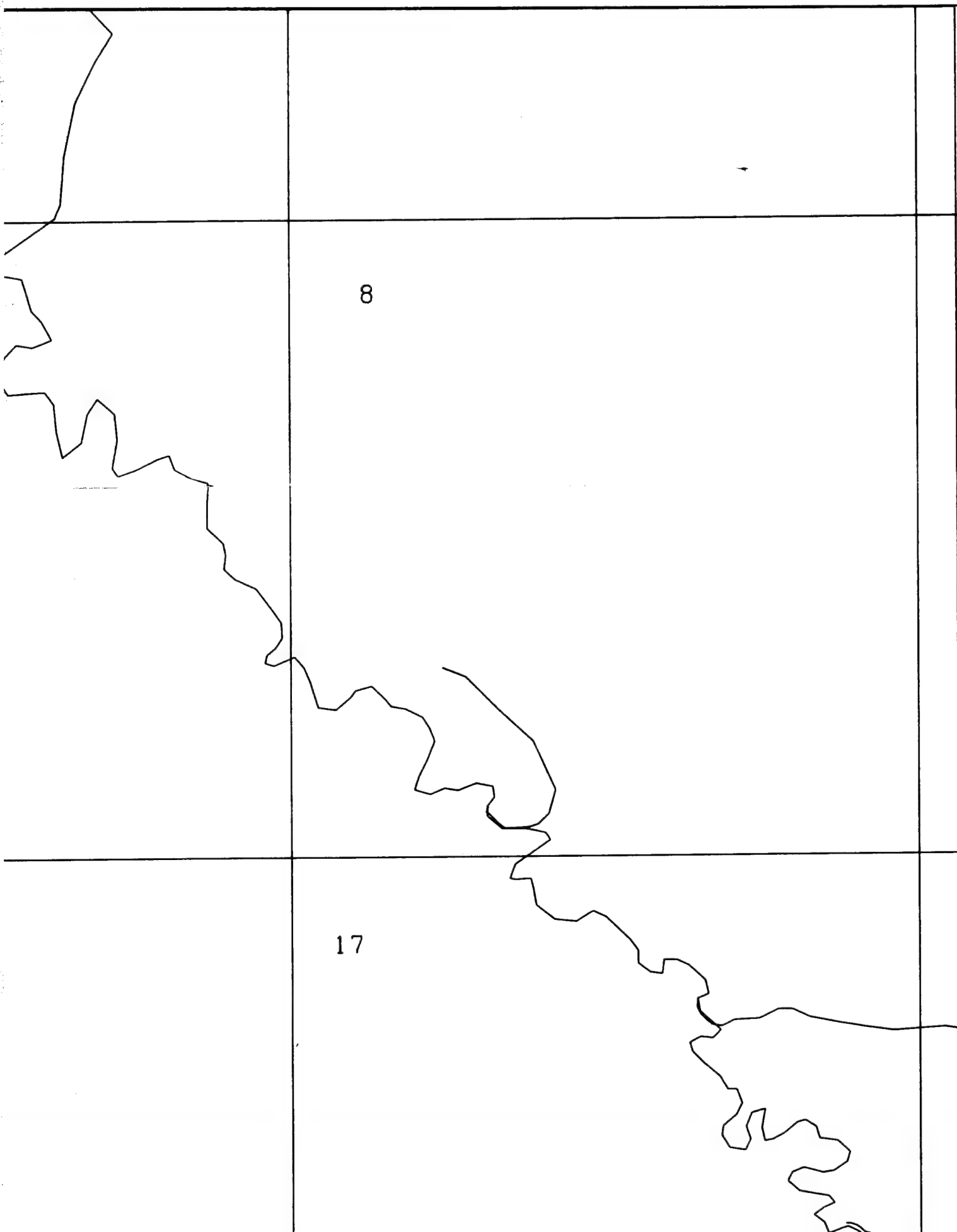
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37321.122

18

37392

37378

37327





37363 X

37351 X

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37361 X

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37382

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22005

37331

37335 X

37360 X

37370

22019 2

37351 X

37340 X

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37346 X

37343.365 X

37313 X

37316.317

37381

37305

37389

37380  
37374.379

37345 X

37380 X

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22006

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23151

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23188-190  
23189

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23142

23191-193 X

23095  
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23179-181

37382

37332  
37346  
22059 X

22044

22007

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37333

22005

22015

22016

22017

22018

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22050

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22031

22011

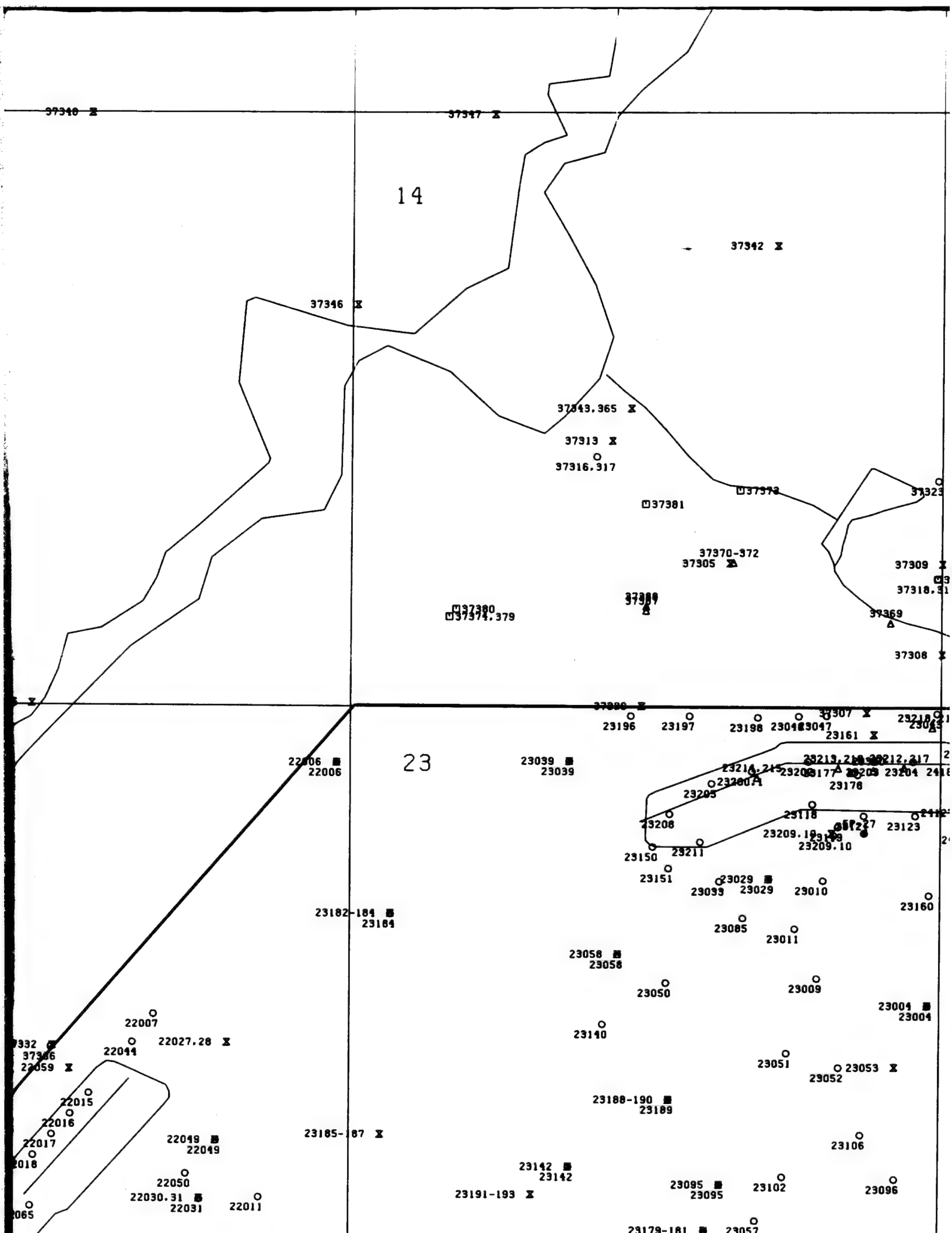
37370

22019

22065

22051

23108



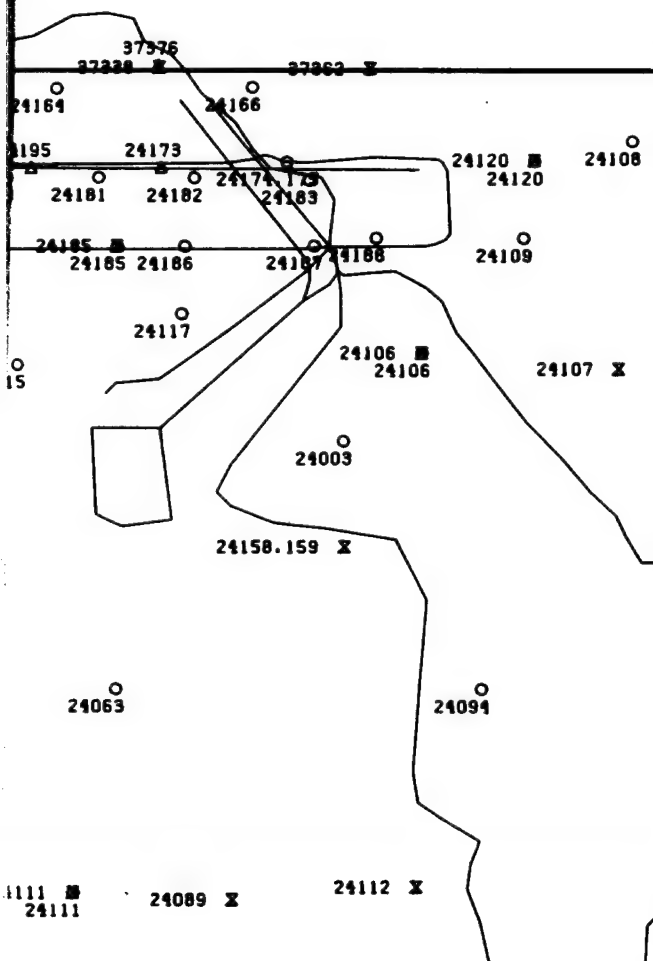


37320 X  
37321.122

18

37392 37378

37327



19015 X

19

19017 X

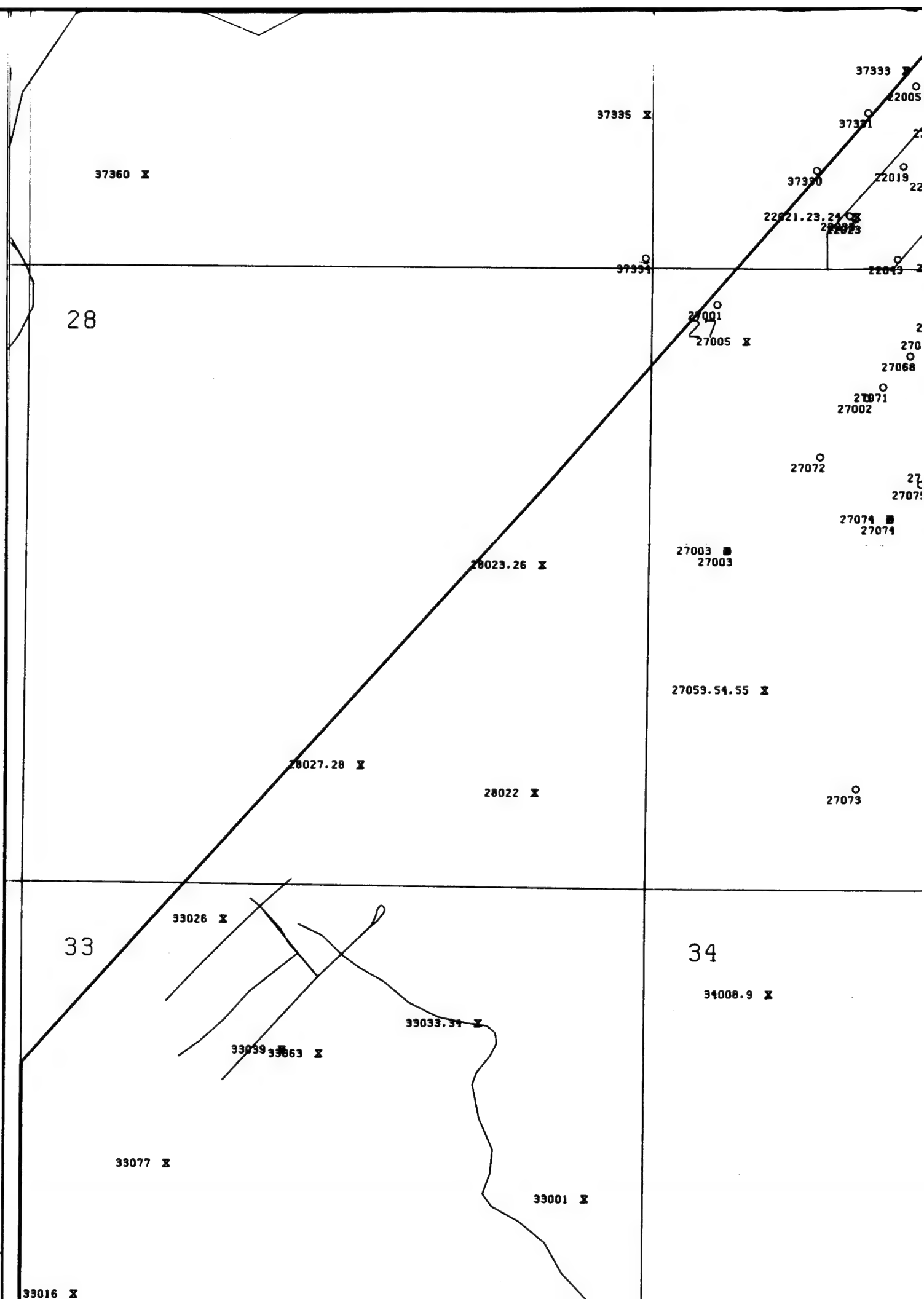
19003 X

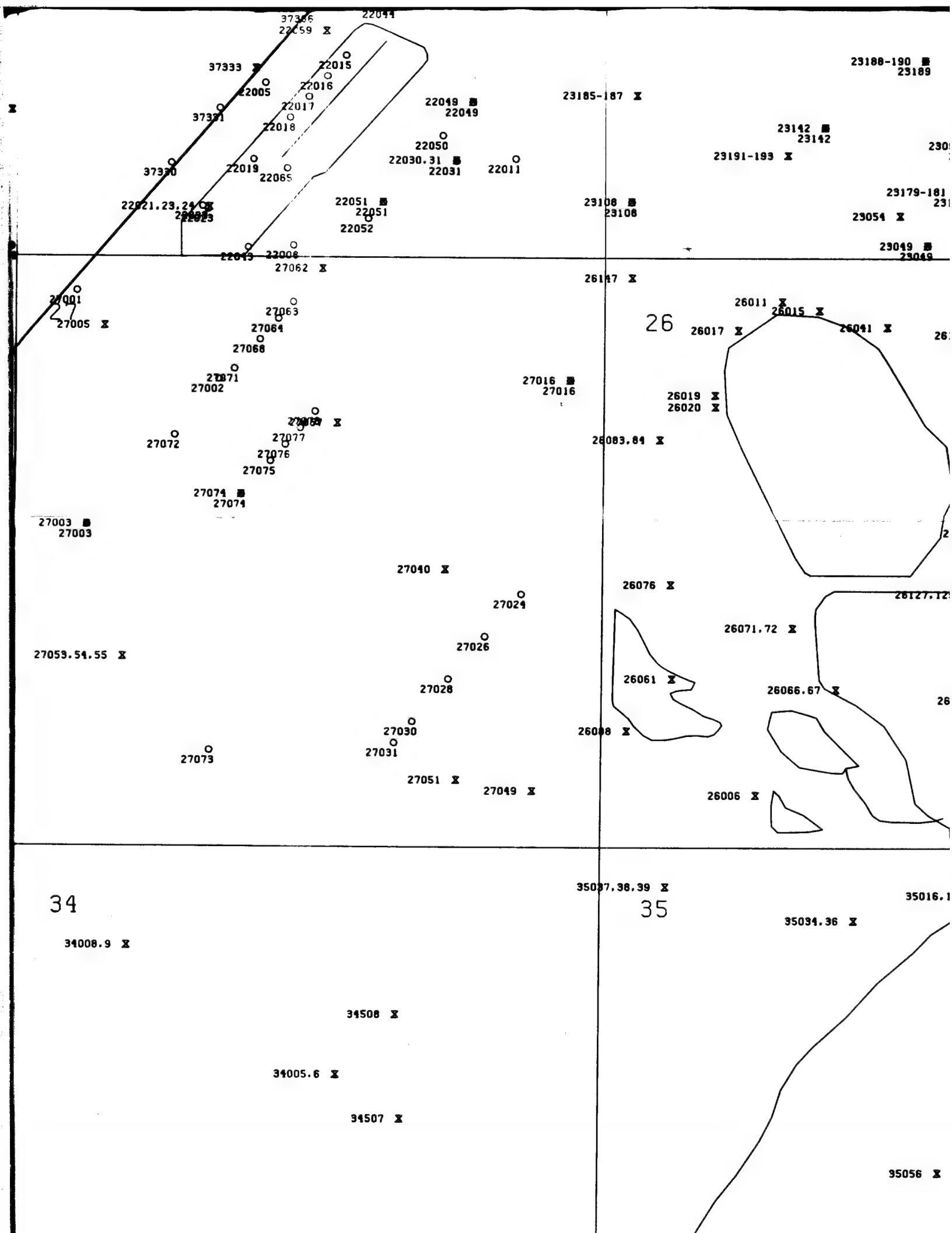
17

19015 X

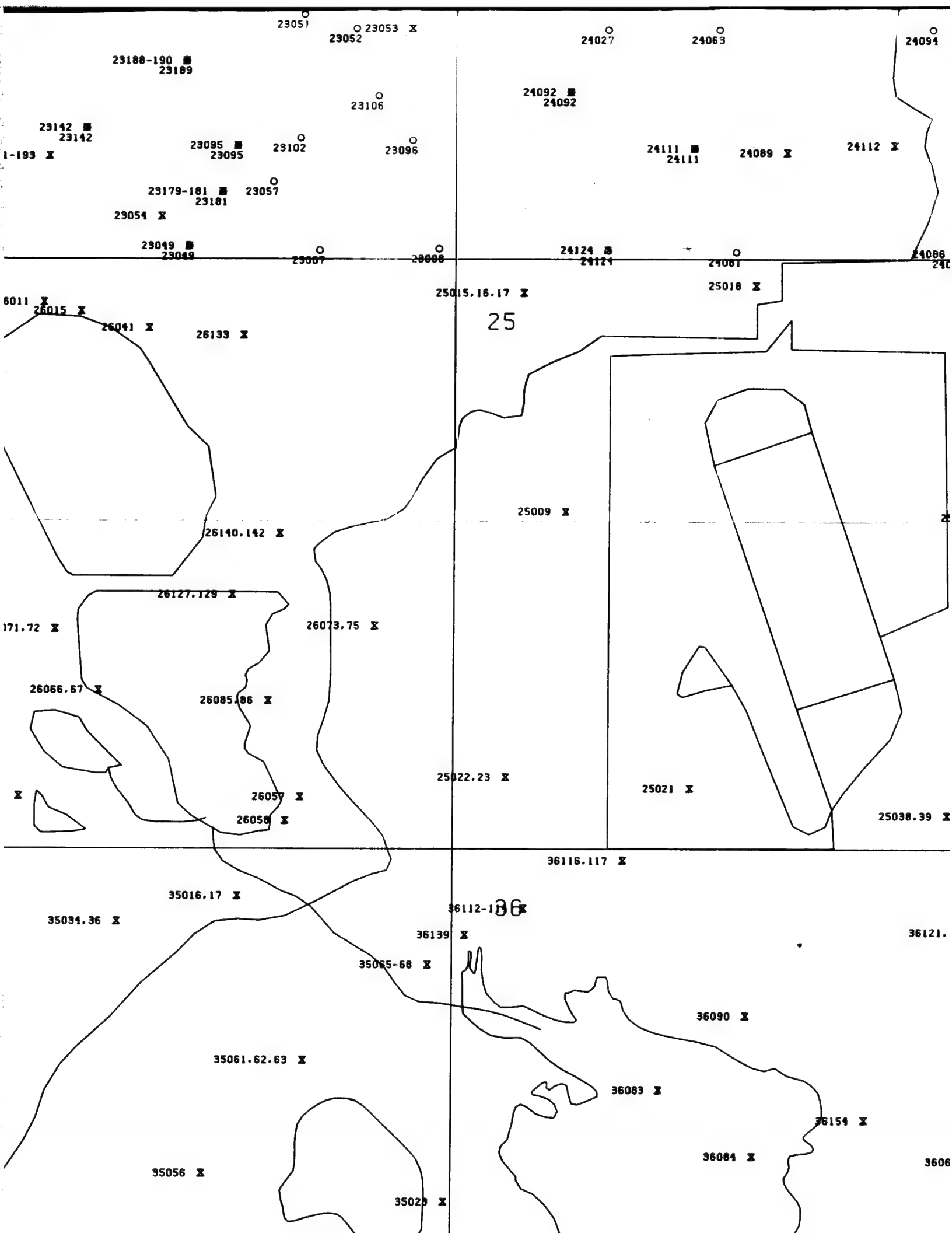
20

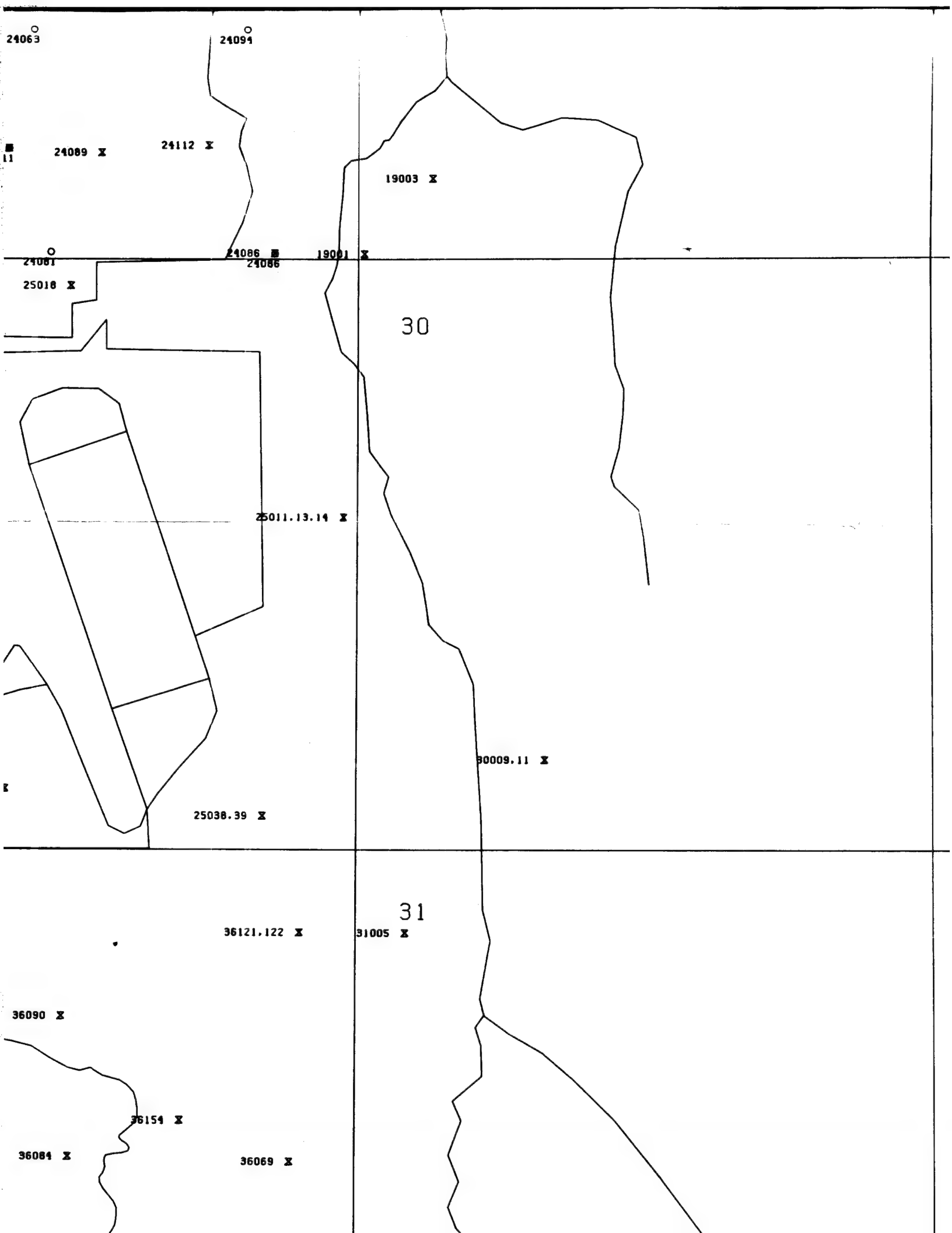
19017 X











29

32002 X

32

33016 X

33030.32 X

34515 X

34002.3 X

33075 X

33002 X

04036 X

04024 X 04021 X 04014 X

03518 X

04007.3.9 X 4

3

04027 X

03002.3.4 X

04010.11 X

04045 X

04030 X

04044 X

03523 X

04041 X

03008 X

04042 X

09010 X

9

10

09002.3 X

09011 X

09006 X

35056 X

35058 X

34504 X

34515 X

34002.3 X

35052.1

03518 X

3

02048 X

02018.19 X

02014 X

002.3.4 X

02032.38.39 X

03005.6 X

02025 X

02008.9.0 X

02034.35.36

03523 X

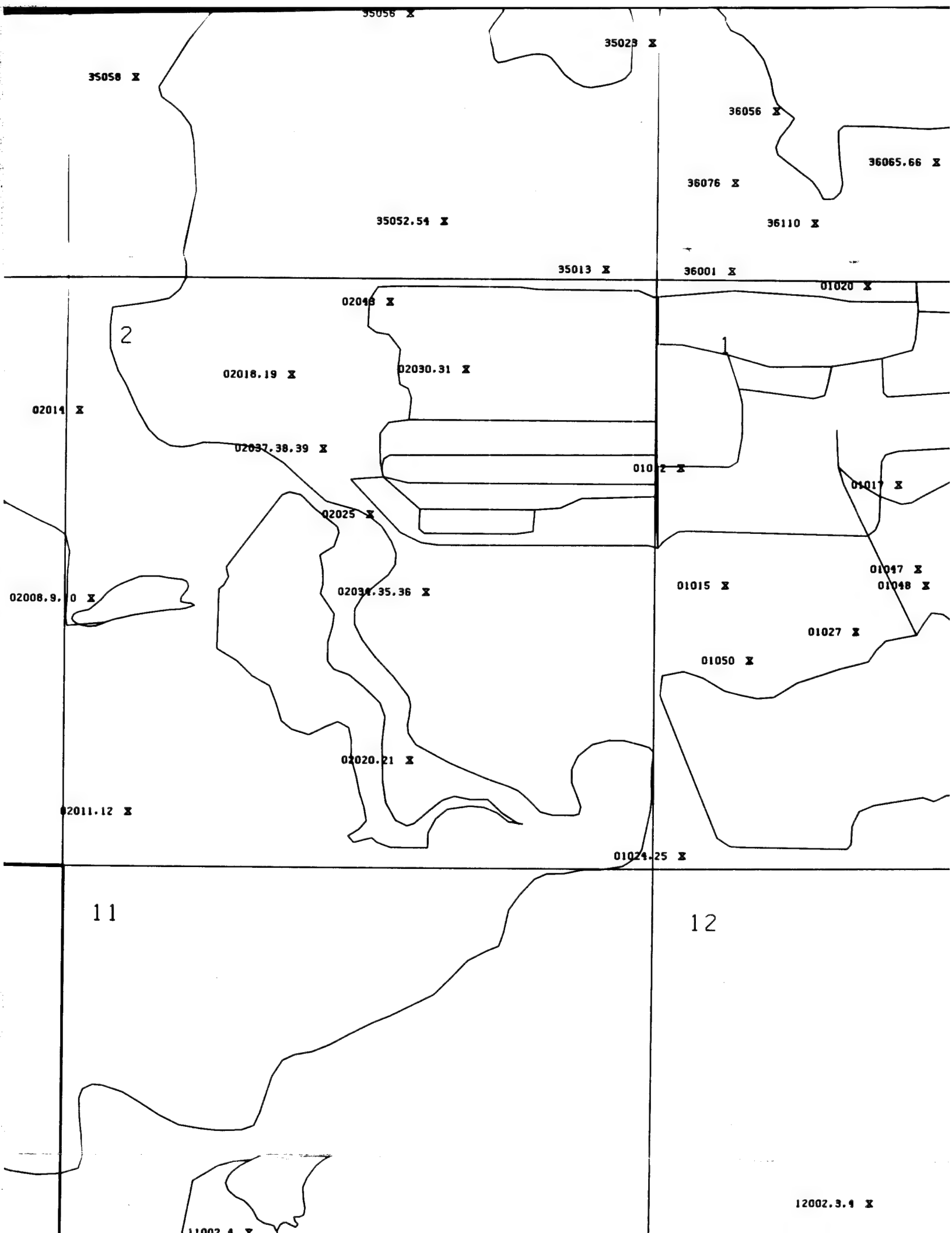
03008 X

02020.21 X

02011.12 X

10

11



35058 X

35029 X

35058 X

36056 X

36065.66 X

36076 X

36110 X

35052.54 X

35013 X

36001 X

01020 X

02048 X

2

02018.19 X

02030.31 X

02014 X

02037.38.39 X

0102 X

01017 X

02025 X

01017 X

01048 X

02034.35.36 X

01015 X

01027 X

01050 X

02020.21 X

01024.25 X

02011.12 X

02008.9.0 X

11

12

12002.3.4 X

11002.4 X

12002.3.4 X

75 X

36119 X

01008 X

06003.4.5 X

6

5

01036.37 X

01041.43 X

06002 X

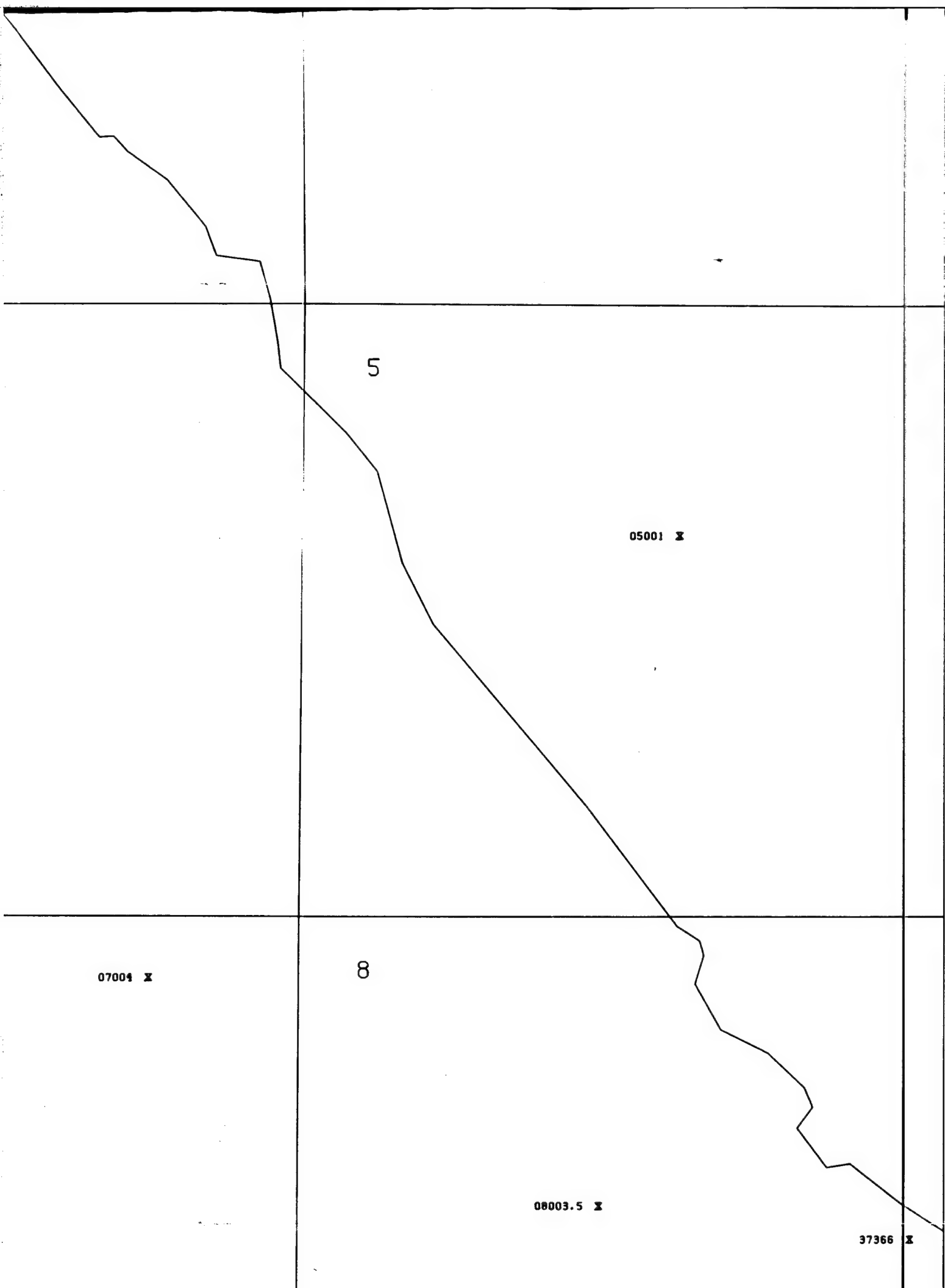
21.22 X

7

07004 X

8





5

05001 X

07004 X

8

08003.5 X

37366 X

09010 X

9

10

09002.3 X

09011 X

09006 X 09005 X

09008 X

09013 X

16

15

TASKS 36, 39, 25, AND 44 ALL WELLS

- △ TASK 36 WELLS (⊕ NOT YET SURVEYED)
- ▢ TASK 39 WELLS (⊕ NOT YET SURVEYED)
- TASK 25 WELLS
- ⊗ TASK 44 WELLS

**Plate 4**  
**GROUND-WATER MONITORING NETWORK, SPRING 1987**

10

11

11002.4 8

15

14

01024.25 X

12

12002.3.4 X

11002.4 X

13

07004 X

7

09001 X

18

07004 X

8

08003.5 X

37366 X

17

TASK 36, 39, 25, AND 44 WELLS

3.00B+0